DEVELOPING EFFECTIVE ONLINE RESOURCES TO ENCOURAGE STUDENT ENGAGEMENT IN CARPENTRY THEORY

A case study of High School Carpentry students in a blended learning environment

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Abstract

This case study examines some key factors that influence student engagement in a blended learning environment, in particular, when using interactive online resources to learn Carpentry theory.

The participants were volunteers from two parallel classes of secondary school students working toward Level 1 Building Construction and Allied Trade Skills Certificate designed for secondary schools by the Building Construction Industry Training Organisation. The participant researcher was also the teacher for both classes.

Data in this case study was collected by observation, reflective journal writing, student records, group discussion and analysis of student course results. It showed that the students responded positively to the blended classroom environment and the interactive online resources developed by the researcher for this study.

The blended learning environment in the classroom increased student participation, aided classroom management, and more than halved the time needed for both classes to finish the Instrumental Drawing Unit Standard 7502 while the interactive online resources enhanced student engagement and achievement in other areas of their theory. Students responded positively to the automated formative feedback and were encouraged by knowing their results instantly; working to gain top results and correct answers rather than just completing an activity by filling in the blanks. A competitive element was introduced by integrating a timer into the resources.

Challenges encountered included limited access to computers and the necessity for students to share computers, a network failure which made the online resources unavailable for an extended period, and storage problems for the online resources to allow them to be accessed from the online learning environment at school and at home.

This study concluded that technology can enable teachers to enhance their teaching and enrich the student learning environment through the introduction of a variety of media. Students still depended on face-to-face teacher input but, in the blended classroom environment and the online environment, the role of the teacher changed noticeably to a role of facilitator.

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Chapter 1. Introduction

In 2008, when the National Certificate in Elementary Construction Skills (ECS) was superseded by the National Certificate in Building Construction and Allied Trade Skills (BCATS) many of the unit standards included a three-fold increase in the amount of written theory to be completed by the students, sometimes more. The theory was not difficult in itself, but because the Building and Construction Industry Training Organisation (BCITO) covered each topic in extensive detail, learning materials were perceived as difficult and boring by the students. The larger workbooks intimidated students with poor literacy and those unused to reading long texts. Observations made during this study by the teacher/researcher showed that students often wrote the first best answer in their worksheets just to "fill in the gaps". The resulting poor achievement and additional marking as a result of many re-sits, led the teacher/researcher to investigate other modes of delivery to encourage greater student engagement with the resources, raise achievement levels and reduce the unproductive teacher workload.

Information and Communications Technology (ICT) is widely used in classrooms in New Zealand and internationally (Means, Toyama, Murphy, Bakia, & Jones, 2010). Improved ICT access for teachers and students at school and at home coupled with the New Zealand Government's roll-out of ultra-fast Broadband (Ministry of Economic Development, 2008) is providing new opportunities for course delivery in the classroom and online. The goal is to provide all state and state-integrated schools with significantly faster broadband by mid-2015 (Ministry of Economic Development, 2012). The Government's intention is that access to ultra-fast broadband will lead to an increase in demand for online content and services by schools (Ministry of Education, 2012). The opportunity for blended learning, that is, traditional face-to-face learning enhanced by ICT, is among the advantages of access to ultra-fast broadband. This mode of teaching is becoming more common, but ICT must be used appropriately to target the needs of the students and to support the underlying pedagogy.

Recent research has revealed the strengths and weaknesses of earlier assumptions about the use of technology (Bennett, Maton, & Kervin, 2008) and shown that successful implementation of ICT in a course is not simply a matter of creating electronic documents from paper resources, but requires teachers to rethink their role, and to take a new approach to course conceptualisation and development (Wiesenberg & Stacey, 2009). Indeed effective blended learning programmes are based on a re-design of an entire course to integrate components and activities, rather than replacing old activities or just adding to the course (Simpson & Anderson, 2009).

Of particular interest for this study is that recent research has shown that practical subjects provide unique opportunities for blended learning (Parkes, Zaka, & Davis, 2011). The introduction of blended learning and interactive online resources in an online learning environment was based on the hypothesis that the use of media-rich resources, search engines and spell checkers as well as greater flexibility in the pace and delivery of Carpentry theory through the use of ICT could overcome many of the difficulties that these students had with their written work. It was further hypothesised by the author of this study that through greater engagement with the learning resources the students would gain a deeper theoretical understanding of the subject which, in turn, could contribute to achievement of the course learning objectives (Geer, 2009; Simpson & Anderson, 2009).

This case study researcher has been a teacher at the high school where the study is situated since February 2003 and has actively promoted the adoption and implementation of ICT in and beyond the classroom. With a background in the construction industry as both a carpenter and, later, as a structural engineer, the researcher has been involved in web design and, to a lesser degree, software development for this industry. Since becoming a teacher in 2002, the researcher has taught Carpentry from Year 11 through to Year 13 and has tutored night classes for Carpentry apprentices up to the NZ certificate in Carpentry. During 2006–2007 the researcher was part of the working party developing the National Certificate in Building Construction and Allied Trade Skills (BCATS), a pre-trade Carpentry programme specifically designed for high schools.

Even after years of streamlining the delivery of the Level 1 Carpentry course, the number of students failing due to poor theory results was a continuing cause for concern. Nevertheless, in a traditional learning environment, the options for modifying the course delivery were limited. Close observation by the teacher revealed that these students were often disengaged, especially with theory, which had to be addressed if their results were to improve. This led to alternative modes of delivery being considered as the content of the course was prescribed.

Identified by the teacher/researcher as contributing factors to the lack of student engagement with paper resources were:

1. Poor reading skills – reading only when absolutely necessary and not at all for pleasure.
2. Poor presentation skills – preferring to do nothing and fail rather than expose this weakness.
3. Attention disorders – focussing on one task for a prolonged period was extremely difficult.
4. Dyslexia – leading to the misunderstanding of tasks and reluctance to write.

A 2008 pilot study by the researcher, adapting the BCITO teaching material for secondary school Carpentry students and presenting it as interactive online resources, showed that this mode of delivery could be effective in encouraging student engagement. The study showed that many of the students had significantly lower computer skills than technology advocates suggested (Bennett et al., 2008; Wright, 2010), but that the students enjoyed working in the online environment and were especially receptive to the instant feedback that these resources could provide. Furthermore, the resources were self-marking, so that students received their results immediately which motivated them to work towards success rather than "filling in the gaps".

This case study investigates how Carpentry students in a particular secondary school engaged with interactive online resources developed to teach Carpentry theory in a blended learning environment.

The research question is:

How do my Carpentry students engage with the interactive online resources in a blended learning environment, which replaced the course resources on paper?

The thesis is structured into chapters starting with this introduction.

Chapter 2 introduces the literature that has informed this study and its central question. The unique position that vocational courses have in secondary education is introduced and the some of the issues surrounding teacher identity and the tension between the traditional skills-based workshop syllabus and the socially contextualised new curriculum. The topic of low literacy and its impact on classroom management issues, future education and employment is then introduced. It is pointed out that while the literature pertains mostly to adult students in vocational education, many of these students originated from classes such as the ones in this study. Next blended and online learning environments are compared to traditional face-to-face teaching followed by a review of literature pertaining to the changes in pedagogy necessary to encourage student engagement in an ICT enhanced learning environment. The chapter ends with a short summary of the literature.

Chapter 3 explains the research methodology and study design. The context of the case study and the interventions to ensure that the students were familiar with all aspects of the study and its underlying pedagogy are introduced. The validity of the data, study limitations and ethical issues are discussed.

Chapter 4 presents the research findings. A case study presents the qualitative data and provides the rich context of the project. The quantitative data is then presented, first, looking at individual student achievement for each unit standard, compared with expected academic achievement based on 2009 Year 10 Assessment Tools for Teaching and Learning (asTTle) test results and overall attitude grade

for 2010 for Carpentry. These results, using student achievement as the unit of analysis, are separated by class and sorted by asTTle result allowing the achievement of individuals to be tracked from one unit standard to the next enabling the analysis of student engagement with activities in different situations. To conclude, the students are regrouped according to course completion and the results analysed using group results as the unit of analysis to evaluate the effectiveness of the online resources developed for the course.

Chapter 5 draws together the findings of the qualitative and quantitative data and discusses these in the light of relevant literature and then concludes the thesis by presenting the main issues revealed by the study. Recommendations are made to inform further research and practice.

This study builds on earlier research findings. Its aim is not to build new theory nor provide definite answers, but to contribute to the growing body of knowledge on interactive online resources designed to encourage student engagement.

Chapter 2. Literature Review

Overview

Technology education has undergone some radical changes in recent years, although whether these changes address the needs of the learners is not yet clear (Brunton & Coll, 2005, 142). In an educational environment where technology education is becoming increasingly academic, vocational education occupies a unique position in secondary schools, bridging the gap between high school and industry (Haycock & Kelly, 2009, 6; Maurice-Takerei & Jesson, 2010, 165; Palmieri, 2004, 11).

The literature reviewed in this chapter investigates blended learning, including interactive online resources, by New Zealand high school students in the vocational subject, Carpentry. Literature on student engagement and learning difficulties identified in some of the students in the group of participants in this study is then related to student achievement and the rationale behind the use of online and blended learning environments as a possible intervention to increase student engagement and the implications for pedagogy is introduced.

Literature was reviewed from the libraries of Canterbury and Massey Universities. An extensive online search was also undertaken, using databases (JSTOR, ERIC, ProQuest, Education Research Complete and others) on the University of Canterbury library website as well as through the online search engines, Google and Google Scholar, to find relevant and up-to-date peer-reviewed literature on the use of information and communication technologies (ICT) and blended learning to enhance high school student learning in vocational subjects. While there is a wide range of literature on ICT and blended learning environments, very little literature is available on blended learning environments at secondary school level (DiPietro, Ferdig, Black, & Preston, 2008, 10; Means et al., 2010, xii; Zaka, 2012, 8) and no literature was found on the use of ICT in vocational education at secondary school level. Where relevant, the literature on adult vocational education has been reviewed later in this chapter.

New Zealand research has been based on small-scale case studies and reviews of international literature. The only larger-scale research came from Europe and the United States. Most research on the use of ICT and blended learning in vocational education has focused on tertiary students and adult learners in New Zealand and internationally. This review starts with a broad overview of technology teachers, trends in curricula in New Zealand and overseas and how this affects students, their needs and academic success.

2.1 Vocational Education, Teachers and Students

Traditionally, technology teachers for hard and resistance materials have had a trade background and, while many may not have practised professionally for a considerable time, they still identify strongly with their trade-based roots and often their identity as a teacher is secondary (Haycock & Kelly, 2009, 6; Maurice-Takerei & Jesson, 2010, 165; Robertson, 2008, 11). In an Australian study on the difficulties of defining "good teaching" in vocational education, Palmieri (2004, 9) suggested that vocational teachers and educators play an important role as a bridge between education and industry. Researchers have acknowledged that this "dual identity" not only influences how the subjects are viewed in the educational community but also influences teacher approaches to teaching and the pedagogies they use (Haycock & Kelly, 2009, 6; Maurice-Takerei & Jesson, 2010, 165; Palmieri, 2004, 11).

While few doubt the expertise that trade experience brings to the technology classroom, since the early 1990s there has been a move away from a skills-based, workshop syllabus with a focus on the development of manual skills and dexterity to a curriculum focused on preparing students to participate in the technological development of their communities (Brunton & Coll, 2005, 142; Ministry of Education, 2007, 17). In fact, the vision statement for technology education in the New Zealand Curriculum states that:

> *In technology, students learn to be innovative developers of products and systems and discerning consumers who will make a difference in the world. (Ministry of Education, 2007, 17)*

While this vision statement appears to address the social and ecological implications of technology, it does not mention the basic skills that many secondary school and polytechnic technology teachers deem necessary to understand and appreciate the systems and materials needed to produce these technological solutions (Bondy, 2007, 15; Maurice-Takerei & Jesson, 2010, 165; Williams & Gumbo, 2011, 55). The case studies researched by Maurice-Takerei and Jesson (2010) on polytechnic Carpentry tutors in New Zealand showed that the expertise and trade experience of the tutors often appeared to be overlooked in favour of a standardised curriculum and quality processes designed for the purposes of compliance.

A practitioner study by Ball (2006, 2), of the Auckland College of Education, indicated a conflict between the technical education of technology teachers where the core focus of their teaching (which revolves around the practical skills in the workshop) and the socially contextualised curriculum (in which the effects of technology in the wider community are considered).

In a series of New Zealand case studies on secondary school technology teachers and their knowledge of pedagogy, assessment and curriculum, Williams and Gumbo (2011, 54) found considerable

disparity among these teachers and their perception of the purposes of technology education. While some acknowledged the importance of NCEA achievement standards and the socially contextualised curriculum they represent, the widespread provision of vocational unit standards in secondary schools has indicated that there are teachers who consider that the development of practical skills and problem-solving should be the main purpose of technology education and believe that achievement standards are too theoretical for the type of student typically attracted to technology education. Williams and Gumbo (2011, 55) observed that, factors such as the facilities at the teacher's disposal and their curriculum knowledge also played a role in their perception of how well achievement standards served the students they were teaching.

Investigating how the 1995 technology curriculum (Ministry of Education, 1995) was being interpreted after its implementation became mandatory in 1999, Bondy (2007, 136) carried out case studies of four New Zealand secondary schools which revealed that many students of lower academic ability, who could not be placed elsewhere, were enrolled into technology classes giving rise to the common perception among teachers that technology and other workshop-based subjects are a "*dumping ground*" for these students (Bondy, 2007, 133). The teachers involved had become concerned that the technology curriculum (Ministry of Education, 1995) with its greater focus on social context and design would disadvantage these students due to their backgrounds, ability and interests.

Bondy (2007, 28) and Middleton (2000, 25) noted that the schools in their studies developed unit standard-based vocational courses to cater for the learning needs of students with lower academic ambitions or students whose academic ability was below what they considered to be the normal academic range. While neither study expanded upon the learning needs of the students, their description of the way in which many teachers in the studies perceive the use of vocational unit standards and the original intent of technology education indicates that they perceived that these students were likely to fail in a course that had become largely academic, especially as students with lower academic ambitions often had difficulty expressing themselves in writing.

2.2 Classroom Management Issues Arising from Low Literacy

While the intention of the Ministry of Education in New Zealand and overseas has been to try to eliminate the divide between academic and vocational qualifications, allowing for multiple pathways and programmes of study and learning, Bondy (2007, 135) reported that, where the new curriculum was implemented, the teachers experienced greater classroom management problems because many of the lower academic ability students lost interest in the what was being taught.

In her textbook on learners with mild disabilities, Raymond (2000, 7) notes that when students with mild learning disabilities fail to succeed there is a rise in classroom management problems faced by teachers. She indicates that many students who fail academically often struggle with written language. The case studies she uses illustrate that although these students often look "smart" they fail to learn and that although they may have an average or above average IQ, their academic success in is often compromised through their inability to express their knowledge through written work and tests. Furthermore, this lack of success often leads to feelings of helplessness which may lead to inappropriate social behaviour (Arnbak, 2004, 464; Bransford, 2000, 246; Buchmann, DiPrete, & McDaniel, 2008, 322; Raymond, 2000, 7, 88-89).

A review of research and theoretical perspectives carried out in the United States on gender inequalities in educational performance and attainment, covering students from early childhood to young adulthood (Buchmann et al., 2008, 322), revealed that boys are over-represented in populations with reading difficulties and further determined that antisocial behaviour and reading difficulties are often linked. The authors found that boys with reading difficulties often developed anti-social behaviour and, in addition, emotional and behavioural problems often lead to poor reading skills. In either scenario, these students were more at risk of repeating a year and were less likely to successfully complete high school or enter college or university. Buchmann et al. (2008) show that there is a link between achievement at primary and secondary school level and the level of tertiary education the student is likely to ultimately achieve. As many of these students become adults with low literacy, the literature on that impact is now reviewed.

2.3 Low Literacy and its Impact on Further Education and Employment

The consequences for adults who have low levels of literacy include reduced opportunities of employment, low wages and reduced ability to assist their children in education (Earle, 2009, 15). These consequences are also outlined in Davis and Fletcher's (2009, 16) literature review of e-learning for adults with low literacy and numeracy skills. The authors cite the 2006 Adult Literacy and Life Skills Survey (Satherley, Lawes, & Sok, 2008, 7 - 10), which states while the situation has improved, over a million adult New Zealanders are missing some of the skills they need to successfully accomplish the literacy and numeracy tasks common in today's society and economy and that approximately 15 percent of adults have very low literacy levels. In a case study of a New Zealand polytechnic, Davis, Fletcher and Absalom (2010, 17) discovered that many of the students had extensive deficits in their literacy skills, indicating that these students are leaving secondary school without many of the tools they require for further education.

While investigating the impact of low literacy on further education, Arnbak (2004, 464) selected the results from the tests on functional reading and decoding skills of 194 adults from a Danish study of over 750 adults and students in formal adult education, where she discovered that while differing levels of literacy were required in various professions, the failure to pass O-level exams or their equivalent would impact negatively upon all levels of tertiary and vocational education. She also reports that many poor readers, including those suffering from dyslexia, fail to finish secondary school with recognised qualifications and were unable to participate successfully in educational activities later in life.

While it might be expected that the poorest readers are likely to have poor decoding skills, Arnbak (2004, 465) identifies that there are many adult learners with adequate decoding skills, whose poor reading can be traced to low levels of education. These students often view written activities as particularly threatening, possibly because writing results in a permanent, visible record of their competence in language and content (Raymond, 2000, 235). To overcome these inhibitions, many computer applications have built-in spelling and grammar checks, search engines with predictive text and thumbnail views of searched items. Pop-up boxes and embedded pictures, audio and video files can also overcome many reading and comprehension difficulties (Fletcher, Nicholas, & Davis, 2011, 23).

In their review of e-learning literature for adult literacy, language and numeracy (LLN) , Davis and Fletcher (2009) and present findings which indicate that e-Learning is relevant and useful for adults with literacy, language and/or numeracy needs. They point out on-going professional development for tutors and teachers as well as changes to programmes and resources are necessary to realise its full potential.

The above research, while pertaining to adult literacy, indicates that there are many students passing through the education system in many countries who would have benefitted from a teaching approach which assisted them in overcoming the limitations of low literacy while still at school.

2.4 Engaging Students and Assisting Learners with Low Literacy through the Use of ICT and Blended Learning Environments

In a review of over 300 current (2005-2010) theses, reports and articles on eLearning, Wright (2010, 2) presents evidence that the New Zealand Curriculum implies that the tools and infrastructure are already available and that teachers now have the skills to implement them. While in daily work, most teachers have become generally proficient in the basics of email, word-processing, using a web-browser Stacey and Gerbic (2009) point out the inaccurate preconceptions by leaders and teachers that

these basic skills will enable teachers to seamlessly integrate communication technology into their practice.

The use of basic combinations of technologies such as a computer, data projector and appropriate software can aid student learning using a variety of pedagogies (e.g. presentation, modelling, collaboration and students' active construction of knowledge) with high student engagement. A teacher would struggle to achieve this without the aid of technology and would be unlikely to achieve similar results. Technologies such as a PowerPoint presentation, can be used well or poorly, with concomitant effects on the audience's engagement and learning (Dede, 2008, 44).

The use of ICT in education is not as straight forward as some would like (Zaka, 2012, 1). In her Australian study on pedagogy in vocational education, Brennan (2003, 55-57) shows that teachers and students are becoming more familiar with the use of ICT in teaching and learning; even in traditional trade subjects where the focus has been primarily on practical work, the computer was becoming accepted as a teaching platform.

Davis and Fletcher (2010, 25), in their research into e-Learning for adult literacy, language and numeracy, agree that introducing and integrating digital technologies into educational provision is a complex process and identified that the key behind successful implementation lies in identifying and catering for learners' lifestyles and needs. However, the rapid and on-going development of digital technologies in the field of e-learning leaves little time for reflection and evaluation on its use making thorough planning and clear objectives extremely important (Brennan, 2003, 55,56; Davis & Fletcher, 2010, 5).

In a recent case study on blended learning in a New Zealand rural secondary school, Zaka (2012, 59, 60, 86) notes that the flexibility of a blended learning environment benefitted teaching staff and students. These benefits included additional opportunities to support low achieving students, off-site access to learning resources and more flexibility in planning and preparation time for the teacher. Cashion and Palmieri (2003, 71) investigated 500 enrolled students and 50 educators in Australia about their experiences with online learning in vocational education. Their findings confirm that the greater flexibility offered by the use of ICT and online learning was the main reason for its popularity with both teachers and students while the greatest detractor was unreliable technology. Davis and Fletcher (2010, 16) also highlighted unreliable or incompatible hardware, software and software updates were considered to be one of the challenges facing educators in the implementation of digital technologies. It would seem that this issue is not being resolved as quickly as some would like because Ko and Rossen (2000) indicated over a decade ago that most of the problems faced by

teachers, even for simple administrative work, were problems with infrastructure and software compatibility issues.

Many studies note that students' ability to use ICT varies greatly (Bennett et al., 2008; Kennedy, Judd, Churchward, Gray, & Krause, 2008, 118; Luckin et al., 2009, 93; Zaka, 2012, 1 0- 12). Stacey and Gerbic (2009) observe that while most students now have access to computers and the Internet and for many, online learning and social networking is already an integral part of their lives there is still a wide range of student ability, experience and comfort level in the use of this technology, debunking Prensky's (2001) myth of digital natives.

Due, in part, to teacher scepticism about how effectively online learning alone could provide the necessary content for trade areas, a blended form of teaching and learning has emerged which provides both flexibility and access for the students to engage with course materials in ways not previously possible (Brennan, 2003, 66). Both teachers and students in that study prefer the blended learning approach as it combines the best features of flexibility and maintains the social interactions of the classroom.

2.5 Comparing Blended and Online Environments with Face-To-Face Teaching

In a recent evaluation in the United States of evidence-based practices in online learning in higher education and secondary schools based on more than one thousand studies of online learning, Means, Toyama, Murphy, Bakia and Jones (2010, 38) found that it was difficult to draw conclusions as to the comparative effectiveness of purely online learning as opposed to blended learning due to the differences in content and quality of instruction and that this contributed greatly to the variation in outcomes of the various studies. However, there is strong evidence to suggest that a combination of online learning and ICT in the classroom can be used to enhance face-to-face learning (blended / hybrid learning), a trend which is fast developing in New Zealand and overseas (Condie & Livingston, 2007, 338; Horn & Staker, 2011, 2; Means et al., 2010; Zaka, 2012, 6).

Students tend to be generally positive about the freedom offered by online learning but not all recognise that it requires a greater degree of organisation and discipline than traditional, face-to-face classes. In addition, in their survey on school ICT projects, Bolstad and Gilbert (2006, 9) found that one of the reasons that it is difficult and challenging to provide any type of online learning in a "one-size-fits-all" approach is because most students in the studies to date have not learned to use ICT to optimise learning experiences. Garrison (2011, 12) and Zaka (2012, 5) both identify that students in

an online or blended learning environment are required to take more responsibility for their learning than in a traditional classroom situation, developing abilities such as self-direction and metacognition.

One of the simplest definitions of blended learning, as it applies to this study, is that it is a combination of physical and virtual environments (Stacey & Gerbic, 2009, 2). Blended Learning has been valued primarily for its flexibility and off-site accessibility in some cases. These pragmatic implications aside, blended learning environments offer teachers a set of tools that expand the teaching and learning opportunities available and help accommodate the varying needs of students through increased interaction due to the types of activities that can contribute towards student learning (Geer, 2009; Parkes et al., 2011; Simpson & Anderson, 2009; Stacey & Gerbic, 2009; Trentin & Wheeler, 2009; Zaka, 2012).

It has been suggested that blended learning should be viewed more as a pedagogical approach which combines and uses the best of face-to-face learning enhanced by the use of technology. Several studies conclude that a harmonious balance of these modes of delivery offers the best outcomes for on-going practice (Powell, 2011; Stacey & Gerbic, 2009). However, in an extensive review of literature related to K-12 programmes in the United States, Cavanaugh, Barbour and Clark (2009, 10). They also found that there was little evidence to suggest that adopting new and emerging technology led to the adoption of new pedagogies.

Cashion and Palmieri (2003, 75) indicate that that the benefits of blended learning will become more apparent in vocational education as the use of ICT becomes further integrated and that including a face-to-face component alongside the online mode of delivery is crucial. Pullar and Brennan (2008, 9) agree, saying some students rely heavily on face-to-face contact for motivation. For these reasons it is useful to review changes in pedagogy with ICT.

2.6 Changing Pedagogical Practices with ICT and Encouraging Student Engagement

Evidence produced by many studies indicates that school teachers who just replace older technology with digital tools will see little impact on their teaching or in the way students learn and that the novelty of the new technology wears off quickly as students find themselves, once again, passive recipients of information (Gilbert, 2005; Wright, 2010, 38; Zaka, 2012, 14; Zhao & Frank, 2003, 809). For this reason, many different and innovative ways of engaging students through the use of ICT have been trialled and implemented such as multi-media, interactive learning, flexibility around time and distance, and alter the pedagogical practices in the classroom to promote interactive and collaborative ways of learning (Wright, 2010, 25). In her case study investigating e-learning initiatives (blended and

online learning) in New Zealand, Powell (2011, 174) found that some of the more mature teachers, because they are secure in their pedagogy, are the most creative when adopting ICT as they can readily incorporate it in their teaching. Powell (2011, 159) and Zaka (2012, 88) noted that a blended learning environment naturally encouraged teachers to move towards a more student-centred approach to their teaching, taking on a role of facilitator in place of their role as the centre of instruction.

The use of ICT in the learning process can allow teachers to work in a wide range of learning styles. As Williams (2000, 19,20) pointed out, catering for a wide range of learning styles presents problems of its own as students then require individual attention even if they are working on the same problem requiring systems that offer great flexibility. However, Cavanaugh, Barbour and Clark (2009, 10) found that commercial course management systems were often restrictive and did not provide engaging, authentic learning experiences. Means et al. (2010, 48) make a clear recommendation that it is important to incorporate mechanisms that promote student reflection on their level of understanding.

Several US case studies showed that having laptops made the students more independent and also focused the students' attention on what they were doing rather than on what the teacher was doing, which allowed the teacher to circulate offering guidance, correction or encouragement rather than lecturing (Windschitl & Sahl, 2002, 178). The implementation of ICT and the use of laptops saw a shift in the role of the teacher and a change in pedagogy. Powell (2011, 159), in a case study of e-learning in New Zealand schools, noted that a shift in teachers' pedagogy had been an important and unexpected benefit of implementing e-learning. Similarly, in another New Zealand study, Falloon (2006, 346-349) found that the students on computers were able to sustain learning activity for prolonged periods. As a result, the teacher was able to spend less time on classroom management, allowing time to work with individuals and small groups. He noted that the learning value was highly dependent upon the quality of the resources.

Simpson and Anderson (2009, 69), in their study investigating the redesign of a teacher education programme in New Zealand, showed how students believed that web-based course components were engaging, and seen to be of most value in achieving their learning outcomes. Alexander and Boud (2002, 4) also stress the importance of student engagement, and the need for students to feel that what they are doing is worthwhile. Dede (2008, 49) cites research by Pintrich and Schunk (2001) on student motivation to achieve educational goals, which is determined by factors such as satisfaction from achievement, contributing to others, and challenge and curiosity.

In the 1990s, educational gaming was seen by many educators and trainers to be a way of encouraging independent learning. Many of these resources were found to be only marginally effective, however, leaving educators sceptical about this attempt to merge learning and fun (Galarneau, 2005). Although research on the development and use of computer games in education is still considered inadequate, part of the appeal of this form of media lies in the possibility of harnessing the high levels of engagement and motivation reported by many game players (Bennett et al., 2008).

However, research by Caruso and Kvavik (2005, 36) on student use of ICT, argue that this strategy, if adopted, must take into account that it is males entering university who report doing a lot of gaming which may limit its effectiveness for female students. Dede (2005) confirmed claims that highly modified game-based approaches can support learning. Galarneau (2005), in her paper examining the suitability of games for learning, takes a similar stance but goes on to state that games and simulations can only be as effective as the pedagogy behind them and that their effectiveness must be measured against the learning objectives, but this was rarely done.

Bersin (2004, 193) points out that the challenge in a blended learning environment is deciding when and where to use simulations, because they are costly and time-consuming to build and, in some cases, the content may be out of date before they are ready for use. Among the benefits of simulations is that the learner is placed at the centre of the learning opportunity in an authentic situation (Galarneau, 2005, 4) and that they allow learning by failure, which in reality would be too dangerous or costly, allowing learners to test themselves to the limit (Bersin, 2004, 193). Davis, Fletcher and Absolom (2010, 18 - 19) noted that the simple inclusion of a bell sound and timer in a building site simulation added a competitive element to the exercise, encouraging high levels of student engagement.

2.7 Summary of Research Relevant to this Study

This literature review has identified a wide range of research relevant to the present study, which is listed briefly below.

Vocational education is an important link between education and industry. However, there has been a move away from recognising the development of manual skills as a legitimate educational focus. Research indicates that moves toward a standardised curriculum appear to overlook the expertise that educators in this sector possess in the vocational motivation of students.

There is greater reliance on the outcomes of written theory to assess the competence of students in technology leading many schools to offer alternative vocational courses using unit standards. Recent

changes in the New Zealand curriculum have led to a shift in emphasis and assessment that requires greater literacy skills, while practical trade skills appear undervalued.

The increase in written theory in all areas of technology education has left many less academic students feeling helpless and has led to an increase in classroom management issues and inappropriate social behaviour, some of which may be attributable to low literacy levels.

Failure to engage these students or provide and implement systems which could support them increases the likelihood that they will finish school without a recognised qualification and reduced future education and employment opportunities.

Current research seems to indicate that ICT has been found to be valuable in supporting the learning and engagement of adults with literacy and numeracy difficulties, especially through the use of media such as graphics and audio. However, it must be noted that weaker students, in particular, still rely heavily on face-to-face tuition.

Changes in pedagogy are necessary if the implementation of ICT is to realise its full potential in education. Some of the most innovative and engaging strategies do not rely on any learning management system, which can be restrictive and limit the ability of the teacher to cater for individual needs. Due to the wide range of student needs and ability, a one-size-fits-all approach has proven to challenging.

While the educational benefits of gaming are still a matter of some dispute, interactive resources and simulations have been shown to be effective and engaging. Some of these resources were also relevant for students with literacy problems.

Research indicates that, with careful planning and clear educational outcomes, the role of the teacher can move to one of a facilitator, which permits a more student-centred approach to teaching. While ICT may not result in new pedagogy, ICT provides a new set of tools to implement old pedagogies in new and innovative ways, although technical issues remain common.

Chapter 3. Methodology and Design

Overview

This Participatory Action Research (PAR) study examines how students interact and engage with online interactive resources developed for a carpentry course in a blended learning environment and investigates how this influences student achievement. In this chapter, the research design is explained and justified and the particular context of the study and its participants are described. The timeline clarifies which activities ran concurrently, signposts the major events during the study, and shows the three phases and their relationship to the development of the online interactive resources. Next, the materials used in the study and data collection methods are explained. Interventions are introduced, and the analysis of the data and the internal and external validity are explained, as are the study limitations and ethical considerations of the study.

3.1 Research Methodology

This study is located within a social constructivist paradigm because it seeks to understand student engagement in a natural setting in order to develop online learning resources to encourage independent learning and active inquiry. The process relies on student feedback about their experience and their results when using the online resources in combination with the teacher/researcher's observation and reflection to further develop the online resources and investigate their effectiveness.

The principles of social constructivism align neatly with the goals of many teachers wishing to encourage students to take responsibility for their own learning. McCarty and Swandt (2000, 49) point out that some of the cognitive abilities that a social constructivist teachers should be fostering in their students (such as comparing, recognising differences and similarities and constructing solutions) require an intimate knowledge of the students and their abilities. This requires teachers to foster those same abilities in themselves when analysing how they interact with their students. It stands to reason that a learning environment developed under these conditions will be the result of complex interaction and negotiation between the teacher and the students.

PAR closely aligns itself with social constructivist approaches to knowledge creation as described by Williams (2007, 3) because of the way that knowledge and theory is generated from practice as a result of the social interaction and negotiation that takes place between the researcher and the participants. The theoretical basis of constructivism for students learning may also guide instructional design in blended learning environments (Geer, 2009, 40).

This study builds upon a previous pilot study in 2008 and was developed within this school to address the lack of engagement of secondary school carpentry students with the BCITO paper theory resources and identify some of the factors contributing to the lack of engagement. This research has made use of the research and developments of others (Yin, 2009) to create both the learning environment and the interactive online resources. In this study the teacher who is also researcher and developer of the teaching materials has adapted ideas from previous studies to address one area of a course in vocational education and observe student reactions to the teaching innovation within this environment. As such, this research may be regarded as a case study where the findings are only applicable to this particular setting within this school environment. While the findings of this study may contribute to the growing body of knowledge on the development of interactive online resources designed to encourage student engagement, it is not the aim of this study to build new, generalisable theory nor to provide definite answers but to examine a particular set of circumstances within their own context.

3.2 A Case study approach

A case study approach allows the researcher to investigate areas where there are no clear hypotheses, and to focus on contextual commonalities (Lapan & Quartaroli, 2009; Recker, Dorward, & Nelson, 2004) which, in this study, included the students' experiences with the course learning resources, the areas in which they struggled and the activities that engaged them. The strength of the case study approach is the ability to examine a "case" in-depth within its real-life context (Merriam, 1988; Yin, 2009). Yin (2009) also states that the more the research question asks "how" or "why", the more relevant the case study approach becomes.

The research question in this study is a "how/why" question, investigating how students interact and engage with the online resources developed for this study in a blended learning environment and the effects on student achievement. The two classes, representing two parallel case studies, are set in a real-life environment where the researcher had no influence over which students are allocated to either class and, other than the use of standard classroom management techniques, had no control over the student responses which, in turn, become part of the research environment. The nature of both the context and the research question lent themselves well to this form of inquiry.

A case study approach was also chosen for this project because of the teacher/researcher's intimate depth of knowledge about the students and the rich description possible that could inform the development of the interactive online resources for this project.

To use Yin's (2009) terminology, this study can be described as an embedded multiple-case case study. There were two cases within a single context.

The unit of data analysis "student achievement" was readily identifiable, as was the cross-case unit of case analysis "group achievement". The two classes of Carpentry students were kept as separate sets of data within one context. In this study, the differences in class size and student ability tested the effectiveness of the online resources under two similar but not identical sets of conditions.

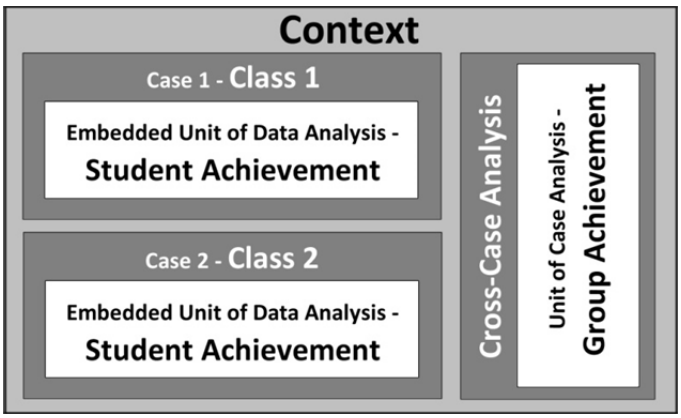


Figure 1 : Overview of the structure for this Multiple-Case Study (adapted from: Yin, 2009, 46)

Figure 1 shows the overall design of the study. Yin (2009) warns that one of the pitfalls of an embedded design is that the researcher focuses on the data at what he terms the "sub-unit level", in this case, student achievement, without returning to a larger unit of analysis, group achievement. To ensure that the focus of the study did not remain at the student achievement level, a cross-case analysis using group achievement as the unit of case analysis returns the study to the level of the original context. Student engagement was observed to evaluate the effectiveness of the online resources developed for the course. Further development of the online resources was an action planned within an Action Research approach.

3.3 Participatory Action Research

According to Williams (2004, 13) in her investigation into contemporary approaches to action research in New Zealand, Participatory Action Research (PAR) is more an approach than a distinct method in itself, perhaps because the uncertain nature of the final outcome when working in a real-life environment where the research participants also have an input as to the direction that the path of inquiry takes requires a flexibility that cannot be achieved by rigidly adhering to a particular method. Kemmis and McTaggart (1988, 10) state that Action Research reflects what every practitioner does to a degree, developing their practice through trial and error, refining their teaching and reviewing outcomes. PAR just does this more rigorously.

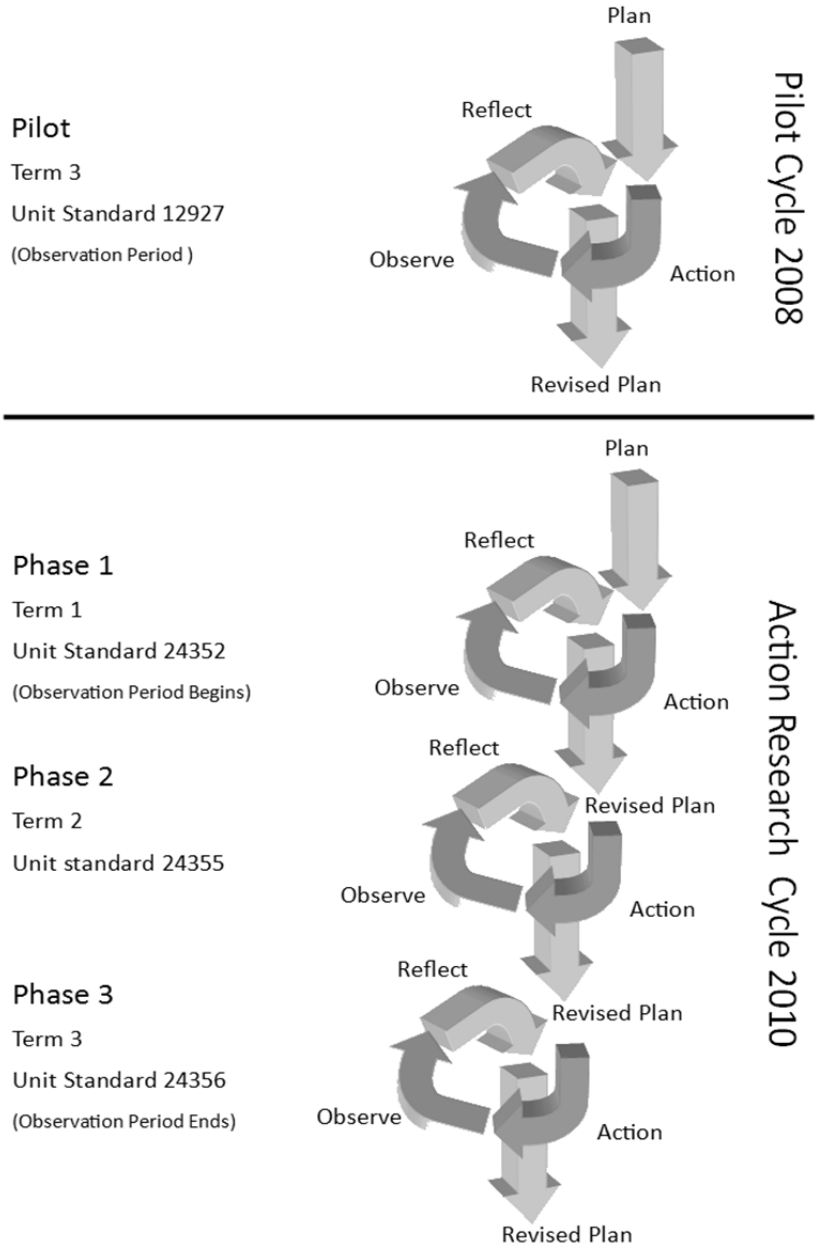
Hopkins (2008, 55) argued that the constraints of research design such as the action research spiral described by Kemmis and McTaggart (1988, 54, 78) act as the kind of constraint action research was originally supposed to alleviate. However, this study benefited from the structure of the Kemmis and McTaggart model for action research. The on-going development and trial process for the online learning resources during the course of the research fitted well within the cycles proposed in the model and the structure guided the researcher and participants in a common direction.

Initially, the goal that had been envisaged by the teacher/researcher was described in broad terms, outlining the kinds of signposts that should indicate a successful outcome. However, as PAR is a negotiated process with many key decisions being made during the research process, the researcher was also prepared to accept an outcome that may not have been envisaged in the original goal. It was a distinct advantage to have a structure that helped ensure that the overall aims of the research were followed while not inhibiting negotiation and decisions on learning resource development.

During the pilot study in 2008 by the teacher/researcher, it had been discovered that students responded well to the introduction of online learning resources to replace the traditional, paper-based theory work. Increased engagement with the resources appeared to lead to better achievement results, even though the material itself was derived directly from the resources provided by the Building Construction Industry Training Organisation (BCITO). The findings of this pilot study prompted further research formed the basis of the current study.

In keeping with the cyclic nature of PAR, this study was run in 3 phases (mini cycles of PAR within the main cycle) which allowed the trial (action), observation, reflection and adaptation of the online resources (revised plan) including two revisions and trials of the online resources during the overall research project, see Figure 2 on the next page.

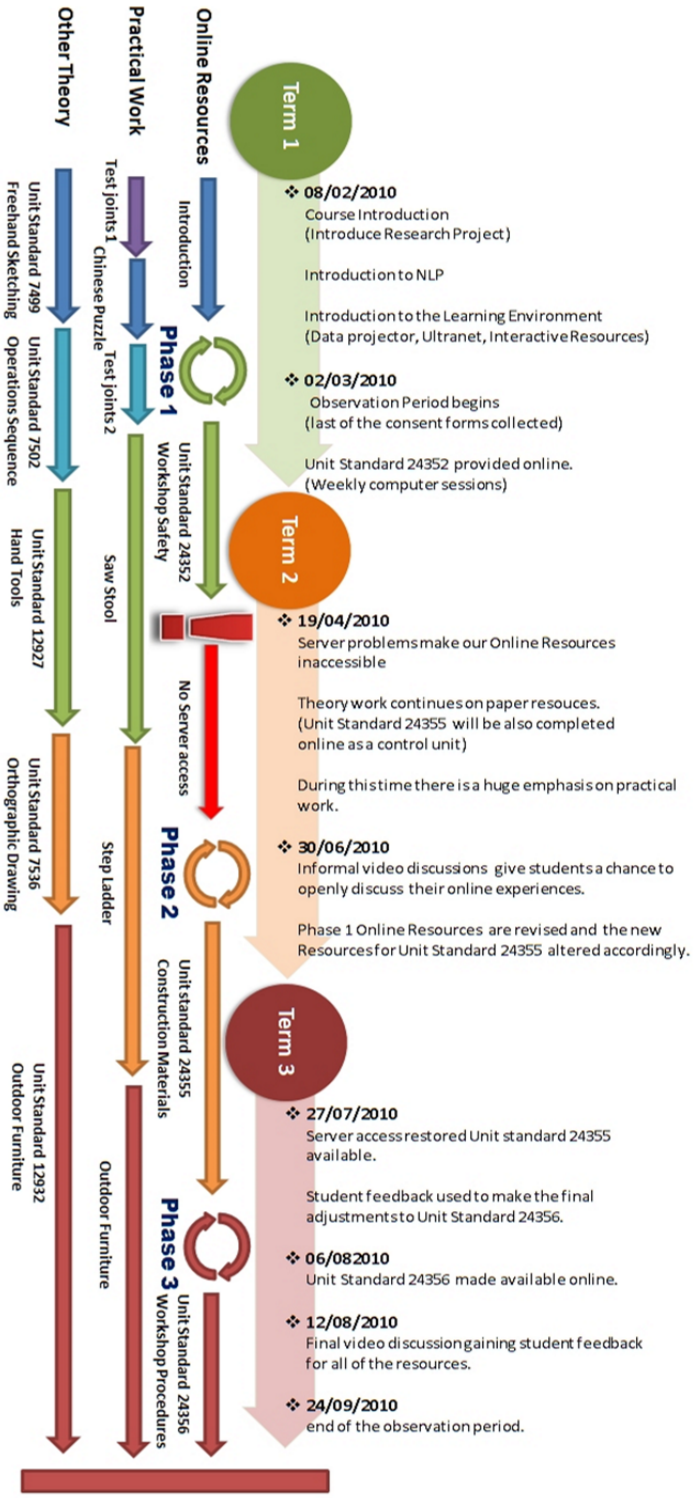
Figure 2: Adapted from the Action Research Protocol from Kemmis & McTaggart (1988, p. 14) showing the relationship between the pilot study and the current study and the cyclic nature of the Participatory Action Research Cycle.



The participatory action research cycle was broken into three phases or mini-cycles. Each phase was carried out over one term as the theory for one Unit Standard was made available online. This allowed on-going development of the interactive online resources, to test the changes and record the results. Term 4 was not used for a fourth cycle due to senior study leave encroached heavily into the time available.

Timeline and overview of PAR cycles

Figure 3: 2010 Study Time Line Showing Concurrent Activities



As Figure 3 shows, the practical work and off-line theory ran concurrently with online theory. A server failure delayed introduction of the interactive online resources for Unit Standard 24355 in term two, during which time the theory for this Unit Standard was completed on the BCITO paper resources. Once the server problems had been sorted out the theory was reassessed using the online resources. By mid-way through the completion of Unit Standard 7536 (Orthographic Drawing) in term two, for which a camera and data projector were used to capture and display the demonstrations, the students were working almost entirely within a blended/online environment for their theory except for their daily Record of Work. Because only six students from the group of participants managed to complete Unit Standard 12932, no interactive online worksheet was created.

Context

This study was conducted at a state-owned co-educational decile 9 high school in the Auckland region. The school has a roll of approximately 1700 students, 20% of whom are international students. Statistics show that the student demographic in terms of ethnic diversity, gender and academic ability closely resemble the national averages.

The school has been active in the promotion of the integration and use of technology across the curriculum, providing professional development for staff, infrastructure and platforms to facilitate implementing blended and online learning environments. The online learning environment used in this study to host the interactive learning resources was Ultranet; a flexible web-based learning management system (LMS) that had already been used in the 2008 pilot study.

The volunteers for this study were from a group of 42 students between 15 and 17 years of age who were working towards level 1 NCEA (National Certificates of Educational Achievement) and taking Carpentry as one of their course options. The students were divided into two classes, one of 24 students and one of 18 students and both taught by the researcher. The classes were not streamed by academic ability; rather, the placement in either class was dependent upon the other options in the students' timetables. Of these 42 students, 30, all boys, volunteered to become participants in this study. Interestingly, the number of volunteers from each class was proportionately similar for each class; 72% in the smaller class and 71% from the larger class.

The students in this Carpentry course were working towards Unit Standards for the pre-trade qualification Building Construction and Allied Trade Skills Certificate (BCATS) from the Building Construction Industry Training Organisation (BCITO). These Unit Standards were cross-credited towards Level 1 NCEA.

To complete the course, the students were assessed on their theoretical knowledge of the subject (general knowledge of materials, safety and construction), their ability to put parts of this knowledge into practice and their practical ability in the workshop using tools and machinery. The skills embedded in the course also incorporated the key competencies of the New Zealand Curriculum and were intended to encourage students to take an active approach to problem-solving and stimulate the learning process through interpreting situations.

Printed and Online Learning Resources, Practical Projects and Teaching Approaches

The theory component was delivered on printed resources supplied by the BCITO, and/or online using resources developed by the researcher from BCITO material. The students then completed this work on printed worksheets or in the computer labs using the interactive online resources developed for this study for written assessments, in their own exercise books for the Record of Work and sketching exercises and A3 drawing boards for Instrumental Drawing.

Printed Learning Resources

The BCITO has developed workbooks specifically for secondary students which constitute the main theory component for most of the Unit Standards in Carpentry and are designed to cover all of the expected learning outcomes for that Unit. These workbooks contain the relevant information for the topic and include optional activities designed to be used as formative assessment during the delivery of the Unit Standard and a compulsory worksheet intended to be used for the concluding summative assessment component. The theory for two unit standards (12927 and 12932, see Table 1 for more detail) was delivered using the printed BCITO material in the same way as in previous years.

Table 1: Unit Standards where the theory was delivered as printed material

Unit No.	Unit Standard Title	Level	Credit	Term	No. Students/ Participants
12927	Identify, select, use and maintain hand tools used for construction projects under Supervision	2	6	1-2	30
12932	Construct timber garden furniture and items of basic construction equipment under supervision	2	8	3-4	6

As far as possible, examples and demonstrations of safety, work methods and the use of tools relevant to the theory were carried out in genuine workshop situations. The workbooks supplied by the BCITO were also used for reference. Following these demonstrations, the students completed the activities and worksheets in class working alone or in small groups.

Interactive Online Learning Resources

The interactive online resources for this study were developed directly from the material supplied by the BCITO using the authoring tools in the "Hot Potatoes" Suite (available at http://hotpot.uvic.ca/), a suite of six applications which allow even those with very modest computer skills, to create interactive multiple-choice, short-answer, jumbled-sentence, crossword, matching/ordering or gap-fill exercises for online use. This development suite is now freeware and, although not open-source, may be freely used for any project.

Table 2 shows the Unit Standards that were adapted using this software. Unit Standard 24352 was the first to be presented to the students in Term 1. At the end of the term the students were asked how they felt the interactive resources could be improved, given the limitations of the software we were using. This consultation occurred at the conclusion of each term for the remaining two Unit Standards.

Table 2: Unit Standards adapted as interactive online learning resources.

Unit No.	Unit Standard Title	Level	Credit	Term	No. Students/ Participants
24352	Demonstrate knowledge of and apply safe working practices for a basic construction Project	1	2	1	30
24355	Demonstrate knowledge of construction and manufacturing materials	1	4	2	30
24356	Apply elementary workshop procedures and processes under supervision	1	8	3	30

To enable the students to access the online learning resources over the school network and from home the Online Learning Environment (OLE) Ultranet (http://www.ultranet.net.nz/) was used. This product is developed by Edtech, a company selected by the Ministry of Education as a preferred partner for the further development of OLEs in New Zealand. As this OLE was being used in other curriculum areas throughout the school many of the students were already familiar with Ultranet. The resulting peer learning enabled the introduction of the environment and learning resources in a time-frame that would otherwise not have been possible.

The interactive online resources developed for this study provided students with formative feedback and hints as they answered the questions; on completion they received a final result. This provided the students with the instant gratification of knowing how well they had done while giving them a sense of certainty that they were ready to progress to the next activity or worksheet.

The terms "activity" and "worksheet" are used by the BCITO to differentiate between resources used for formative assessment (activities) and those which are used as summative assessment (worksheets).

The activities are optional and may be replaced with other resources or forms of evidence, whereas the worksheets are compulsory and are part of the final assessment of the relevant unit standard.

Figure 4, Figure 5 and Figure 6 show examples of feedback when checking an answer (Respectively: the overall score with additional information on how to continue, a hint when unsure of an answer or its spelling and feedback to a query when the student is unsure of the question or requires clarification).

Figure 4: Unit Standard 24352 – Activity 3. An example of the screen when an answer is checked. The correct answer is left in bold type and the incorrect or incomplete answer remains in a textbox.

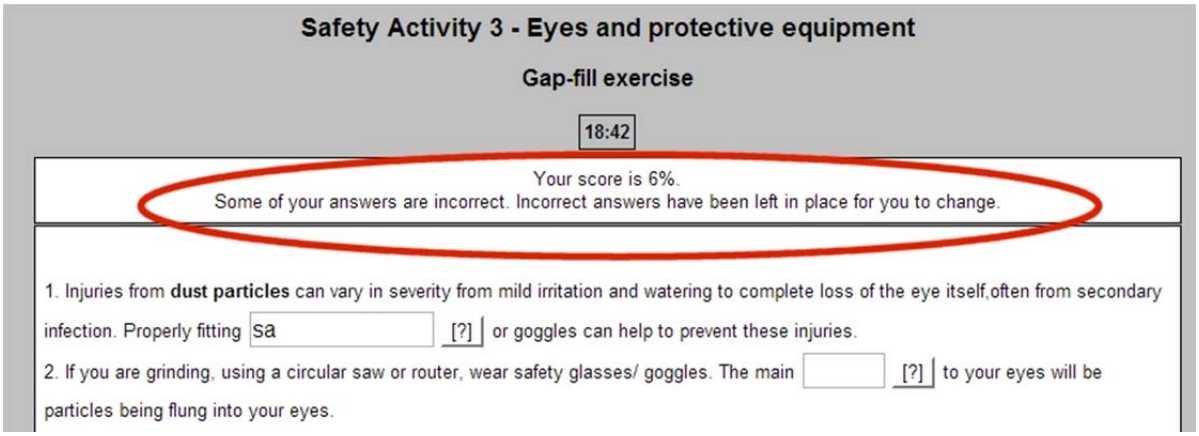


Figure 5: Unit Standard 24352 – Activity 3. An example of the screen the hint button is clicked. A penalty is incurred and marks are lost if this is done.

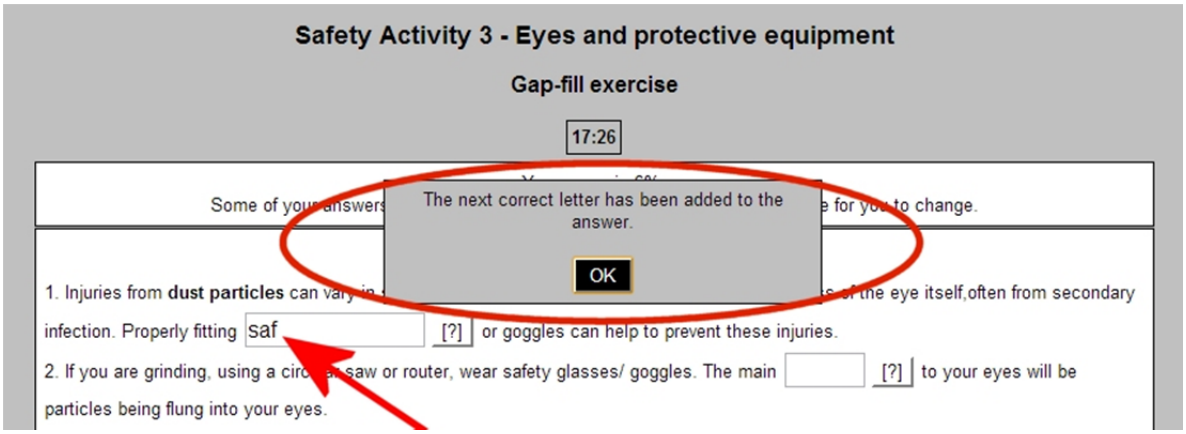


Figure 6: Unit Standard 24352 – Activity 3. An example of the screen if the query button is pressed. This is for clarification and no penalty is incurred and the students' results are not affected.

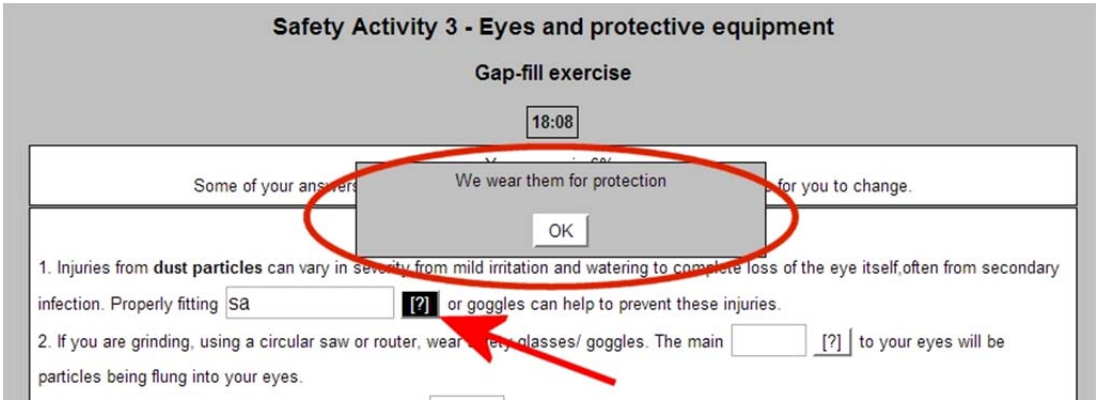


Figure 7 and Figure 8 show two more examples of feedback. The first reinforces the correct answer and the second is a gentle reminder to re-read the question and reassess the level of protection required for the task.

Figure 7: Unit Standard 24352 – Worksheet. An example of the feedback when a checked answer is correct.

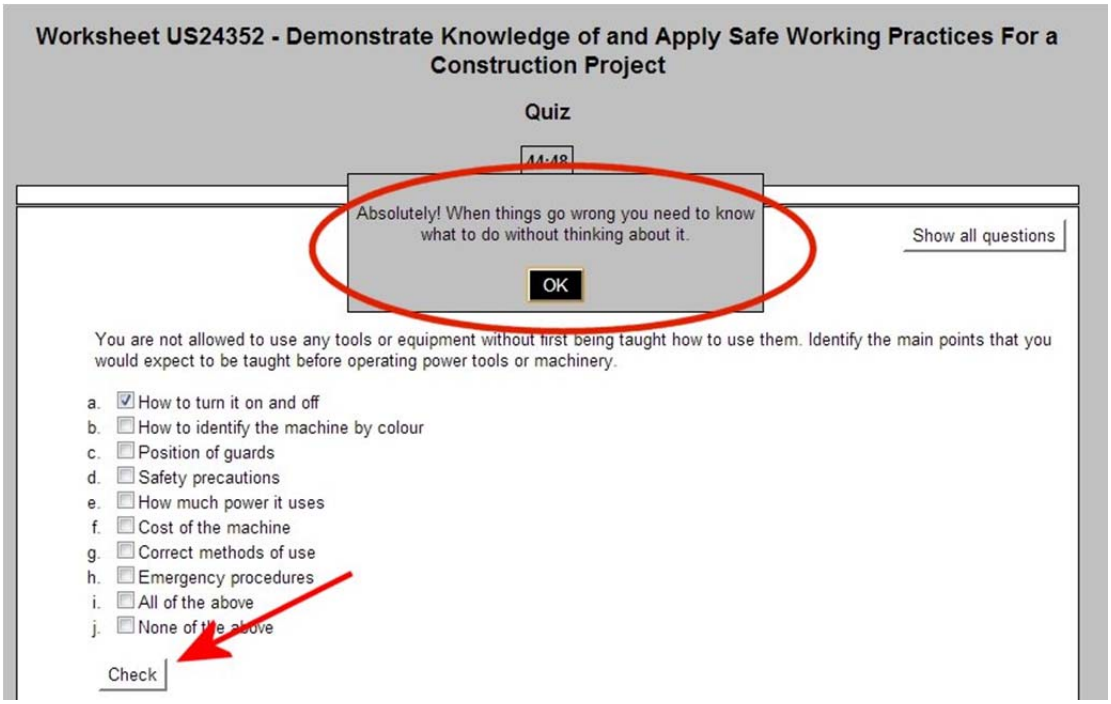


Figure 8: Unit Standard 24352 – Worksheet. An example of the screen when a checked answer is incorrect.

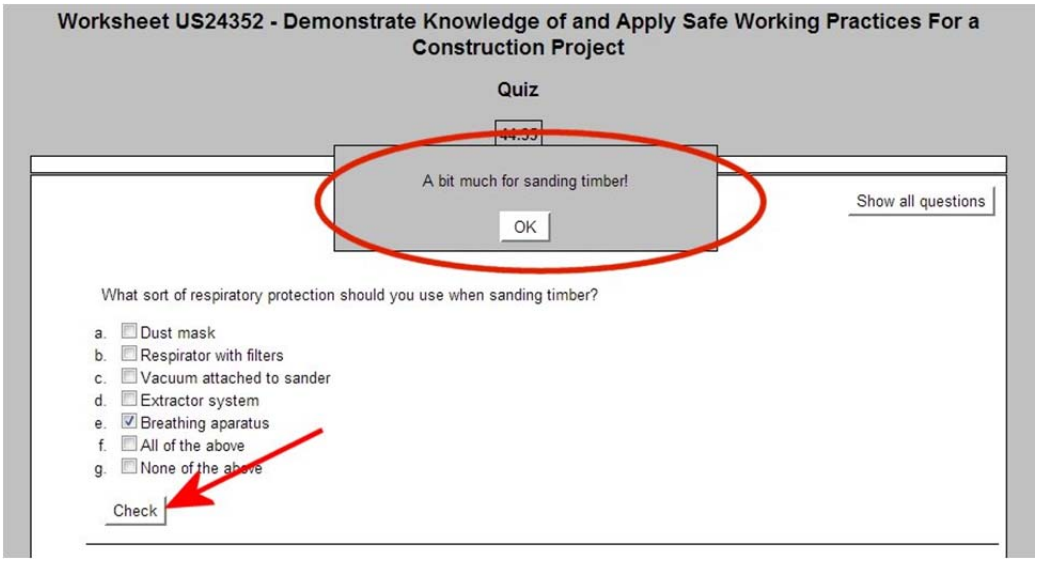
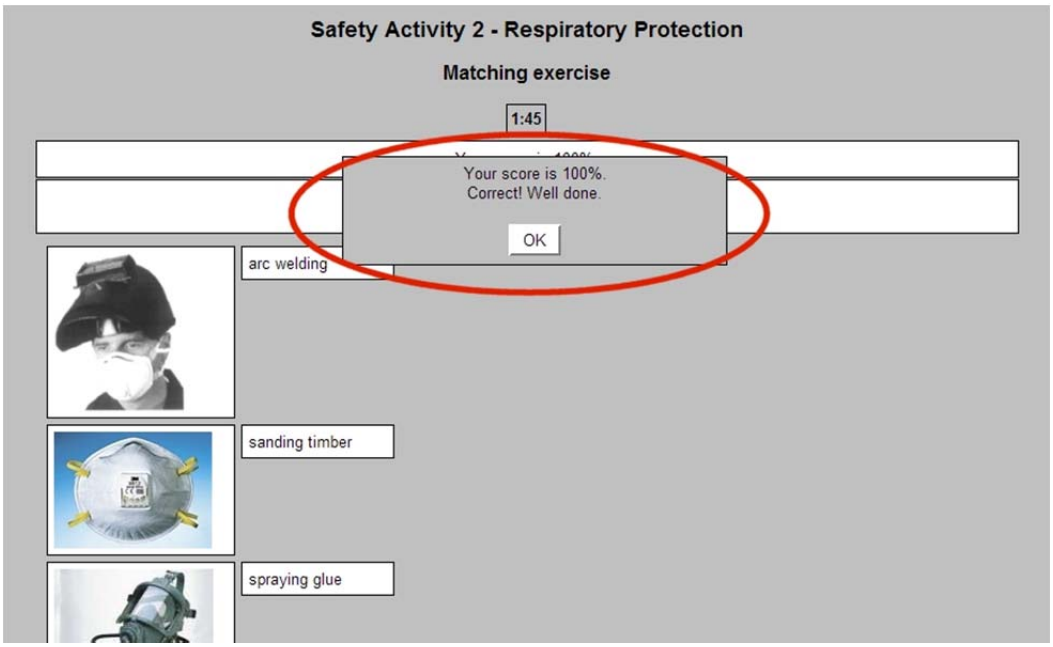


Figure 9 shows an example of the screen when the final score is checked. At this point, as the activity cannot be saved, the students submit their work by printing the sheet to paper or as a digital file in PDF format and putting it in the drop-box or as an email attachment.

Figure 9: Unit Standard 24352 – Activity 2. Once the activity is completed the student can obtain their score immediately.



Practical Projects

Five practical projects are part of this Carpentry course. Of these, the first four must be successfully completed for the student to pass the course. The final project may also be completed as part of the Level Two course, if the student continues with the subject. The projects (Table 3) have been selected for the course as they include the skills and tool use required to pass the associated unit standards.

Table 3: Good examples of the five practical projects set during the course, their descriptions, the relevant unit standards and the term in which the project was initiated.

Project	Description	Unit Standard	Term
Chinese puzzle 	An exercise in to familiarise students with hand tools such as the chisel and mallet as well as measuring, marking out and accuracy. It is expected that students complete this project by the end of Term 1	12927	Term 1
Test joints 	A project to learn the construction joints and familiarise the students with the tools required for the saw stool project. This project should be completed by the end of Week 2 in Term 2.	12927	Beginning of Term 2
Saw stool 	The final hand tools project and the second project in Term 2, the students are expected to demonstrate the skills learned from the previous projects. The project should be nearing completion in Week 6.	12927 and 12932	Mid Term 2
Step ladder 	This is the first project using machines and power tools. It introduces the skills required for the final project. Students who are still on target with their work should complete this project in the last 4 weeks of Term 2.	12932	End of Term 2- Beginning of Term 3
Outdoor Furniture 	This is the final project towards Unit standard 12932 and is designed to teach the use of templates and the efficient use of workshop machinery. This is the final assessed project of the course and should be completed by the end of Term 3. Week 2	12932	End of Term 3- Beginning of Term 4

During every practical session in the workshop, an animation of the construction process for the current project was projected onto a screen in a continual loop. This allowed students to follow the instructions and construction sequence for the project without the need to ask the teacher. This innovative strategy was designed to assist the students to become more self-reliant in problem-solving and to reduce interruptions through repetitive basic questions, thus leaving more instruction time for both advanced and struggling students.

Other Learning Resources and Teaching Approaches

Three unit standards did not have pre-prepared BCITO learning resources to accompany them (see Table 4 for more detail).

The first of these was Unit Standard 7536 that required the students to develop a sequence of operations for a one-off process. The students were required to do this for every project, so that they took time to analyse the logical progression of a project, producing their own step-by-step written instructions in their exercise books. It became apparent which students had difficulties in their presentation skills as the books were marked.

Unit Standard 7536 assessed skills of communication through sketching. Annotated sketches of the major stages of each project enhanced and clarified the sequence of operations. The students were required to use both 2D and 3D sketching techniques. To assist students, each stage of the construction process was drawn on the whiteboard similar to the process in a standard graphics class.

In Unit Standard 7502 a blended learning environment was created by using a high-definition webcam, laptop and data projector. This allowed the demonstration of drawing techniques while facing the class, an action intended to counteract classroom management problems resulting from the loss of eye-contact when drawing on the whiteboard as well as showing the progress of the drawing from the same perspective as the students' and on identical equipment. Recording the demonstration to allow instant replay of difficult techniques was intended to allow absent or slower students to benefit from the demonstration.

Table 4: Unit Standards 7536, 7499 and 7502 showing the title, level and credit value of each standard and the teaching/learning medium and term.

Unit No.	Unit Standard Title	Level	Credit	Medium	Term
7536	Develop sequence of operations for one-off construction in process	1	3	White Board/Exercise Books	1
7499	Use freehand sketching for graphic communication	1	4	White Board/Exercise Books	1
7502	Produce an instrumental orthographic drawing	1	4	Blended Learning Environment/Exercise Books	2

A laptop, data projector, speakers and a high quality web-cam were use to create a blended learning environment in the classroom. This combination of technology allowed:

1. Access to the Internet to bring outside information into the classroom.
2. Access to the interactive online resources in the online learning environment.
3. Video and film material to be played.
4. Demonstrations to be displayed and recorded to be played back at will.
5. Animations of the project work sequence and assembly to be played in a loop.

Introducing this technology allowed the teacher to face the class at all times, aiding classroom management, allowing instant replay of difficult demonstrations, and freeing up teacher time by displaying basic information for the students to access.

3.4 Research Instruments

Overview

This section describes the research instruments used in this study. Firstly, the archival records used to compare the students at local and national level are listed. This is followed by a description of the guidelines used by the participant researcher while observing the students at work and the reflective journal entries made by the participant researcher. The use of student assessment results in conjunction with other data is then outlined and the student "Record of Work" is described. Finally, the usefulness of the informal video conferences is commented upon.

Archival Records

A teacher/researcher has a distinct advantage over an independent researcher when it comes to accessing archival information such as test results and school reports. These records can provide valuable points of reference or a means of comparison that cannot be provided by any other means. As Yin (2009, 102) points out, independent researchers may find that such information is deliberately withheld or access restricted due to privacy reasons. Even if the information itself is not going to be used, the insights into other areas of student achievement that this information reveals may not be obtained from these sources. Because accessing such information falls within the normal role of teachers, they are able to inform themselves fully about the students in their care. Of interest for this study was information that allowed group comparisons, as well as information that could indicate the level of student engagement in other curriculum areas. The following data was accessed with the knowledge and consent of the school's senior management and the participants.

The student profile from the school enrolment records provided current background information on the students participating in this study. Of particular interest for this study were student age, gender and ethnic background as it allowed demographic comparisons between the participants in the group, the New Zealand population, the Auckland Region, the local population and school population

For this study, the Year 10 Assessment Tools for Teaching and Learning (asTTle) records from the previous year were accessed to provide insight into the level of literacy and numeracy of the students. As these results are often used to predict student achievement in academic subjects, often influencing course selection, it was of interest to see whether there was a correlation between the students' asTTle grade and their achievement the following year. As this result would not change, it was decided to use this as a constant value to sort the data gathered about each student in their respective classes. In this

way, the same student would always be in the same position in tables, graphs and charts, enabling quick comparison of their achievement in different situations.

In addition to the students' asTTle grades, the "attitude and effort" grade (Henceforth referred to as attitude) for each student was displayed in the graphs as an additional means of comparison (see Appendix H: Teacher guidelines for assessing attitude). The average attitude grade for the year across all subjects is used by the school to calculate an overall "self-management" grade for each student. The overall attitude grade from the previous year was used as the initial benchmark and the attitude grades were then tracked for each student throughout the year. The attitude grade was used as an indication of a student's overall engagement in schooling and minimised fluctuations caused by teacher bias in individual subjects thereby facilitating general comparisons with the wider school population.

As report comments can be highly subjective and can reflect a bias of the author (Yin, 2009, 102), a student's report as a whole, gives an indication as to which curriculum areas motivated the student. Initially, the intention was to use the changes in report attitude and effort results throughout the year as a variable to measure changes in student engagement. However, on analysis, the results showed that these grades changed very little throughout the year and it was decided to use this data as a second constant value in the charts, to indicate changes in student attitude by measuring this value against student results for specific tasks and activities.

The school's reports also recorded the students' participation in extra-curricular activities, their achievement in core subjects, and the level of their option subjects (e.g. a year 12 student taking a Level 1 subject). This information helped in the interpretation of the study data, and provided a glimpse of the students from the perspectives of other teachers.

Observation

In any social research, observation is a powerful tool for obtaining data about how people act and react in a particular situation. A teacher/researcher has the advantage of being a normal part of the classroom being observed, so that the situation is not artificially influenced. But the demands on teacher time during class, and the teacher involvement with individuals, can adversely affect the reliability and objectivity of observation. Therefore, careful planning is required.

It is important for the researcher to establish the criteria of what to look for during the observation. If the focus of the observation is too narrow, important behaviour or interesting anomalies may easily be missed or not recorded. If the focus is too wide, the observer may well rely too heavily on

"subjective" judgements. Hopkins and Ahtaridou (2008, 77) warn that without a clear focus, the observer is often tempted to prematurely judge a situation.

Open observation was used for this study, in as far as each recorded lesson started with a blank page on the tablet PC used as the recording device, and no "structured" tally charts were used. "OneNote" from the Microsoft Office suite was used by the observer as a notepad which allowed both handwritten entries and sketches to be made on one continuous page while moving around the room. Events were factually noted as they happened without judgement. If necessary, notes were made about a general situation at the time to provide a context for behaviour or actions that required further explanation. In spite of the "open" observation format, important areas to watch were planned (see Table 5) and provided a definite focus determined by the research question enhanced by the teacher/researcher's own experience in this subject. The comments in the notes provided a context for evaluating the data once the observation was over at the end of the year.

Table 5: Outline of the dual focus approach to observation made possible by a participant research approach. One set of criteria assumes impartial observation, the second set of criteria takes advantage of the researcher's in-depth knowledge of the students and learning resources.

Planned impartial observation criteria to guide the researcher's recording of occurrences during the observation sessions.	
Focus	**Reason**
Student computer literacy	To inform the degree of difficulty that could be integrated into future development of the online learning resources.
Student learning strategies	Investigating how the students worked in the online environment. Did they work from start to finish or pick a certain type of activity first? Did they use other programmes, sources of information or elicit help from classmates?
Student engagement	Observing how the students worked with the interactive online resources developed for this study. Were they engaged or distracted, on-task or off-task?
Criteria using the researcher's knowledge to differentiate between usual behaviour and heightened levels of engagement, co-operation and work patterns.	
Student engagement	It was obvious to an experienced teacher that the students were far more engaged when working online than on paper.
Student co-operation	Instead of copying from each other, students actively sought the correct answers and information together, mostly in pairs, sometimes in groups of three.
Student work patterns	Students worked towards success and completion instead of just trying to fill in the gaps on a sheet of paper. The students spent less time off-task than with paper resources and seldom attempted to surf the Internet, previously a problem with other forms of online work.
Student achievement	As the online resources were self-marking, the high student results, often 90–100% instead of the usual 20–40%, were immediately apparent.

Teacher's Reflective Journal (Field Notes)

The field notes provided a simple way of recording actions and events as they happened. McNiff & Whitehead (2002, p. 77) warn that practice is needed to avoid distortion through subjective judgements during the data collection. Initially, the field notes just recorded everything seen, but the notes were refined over time as patterns emerged (Johnson, 2005, p. 63). Using "One Note" and Microsoft Excel, notes were reorganised at a later stage in a systematic fashion (McNiff & Whitehead, 2005, 65). Field notes fall into two categories as outlined by Johnson (2005, p. 65):

1. Quick notes during the lesson – short descriptions of events as they occurred. These formed the basis of the observation notes and were structured as outlined in the previous section.
2. Notes and reflections after the lesson – these were additional notes, insights and reflections on the lesson itself.

Through these notes it was possible to focus on a particular issue over a period of time, reflecting on classroom impressions and atmosphere.

Student Records (Assessment Results)

Student assessment results from work completed during a course are usually used collectively to measure student achievement in order to decide whether credits for a particular unit standard are to be awarded. Johnson (2005) states that student results should not be used as the only source of data, indicating that although these data is quantifiable and easily displayed and analysed in spread sheets, graphs, and charts, without triangulating these results with other data sources, concerns may be raised about the validity of any conclusions drawn. For the purposes of this study the results have not only been used as assessment tools but have also been analysed separately to be used as an indicator for changes in student attitude and engagement for individual tasks when measured against the attitude grades in the students' reports.

Record of Work (Daily Work Diary/Journal)

The record of work was developed by the researcher to encourage the students to plan, record and analyse their own progress and as a data source to gauge student progress in understanding their tasks, enabling formative feedback, independent of any assessment work. When used as a form of data collection, Hopkins and Ahtaridou (2008, 109) show that any student journal provides a student's perspective on a given task and can be easily integrated into the lesson. McNiff & Whitehead (2002, 77) agree that student journals can provide useful insights into the participants' view of their work although that could be highly subjective. In this study, they provided a useful reference for the

triangulation of data when compared with the observations, the actual results and also the researcher's own reflective diary (McNiff & Whitehead, 2002).

Every period the students were required to make entries in three columns in the back of their exercise books. The first column, "Goal" stated what they intended to achieve for the period. The entry was based on entry from the previous period and the instructions for the project written down in the front of their books. Students were instructed on how to write specific, achievable goals as part of the course.

The second column, "Achievement" was their own measurement of their goal. Students simply recorded what they had actually achieved for the period. The third column, "Analysis" was for the students to analyse their own progress (how and why), including any difficulties they may have faced, and explanations for any differences between their "Goal" and what they actually achieved as well as any information they required for their goals in the next period.

Through the entries in the students' Record of Work, it was possible to get an indication of how and if the students were applying the strategies they had been given. These entries also gave valuable insights into the students' understanding of the problems they faced and became a written record of performance-based assessment from the viewpoint of the individual student.

To aid student understanding of the pedagogy behind the Record of Work, some of the basic methods used in Neuro-Linguistic Programming (NLP) were employed to show the students how they could influence their own learning and outcomes as outlined in the textbook The NLP Guide by Alder and Heather (2003), two of the most experienced NLP trainers in Britain.

In ten minute sessions at the beginning of each lesson in the first six week of term one, the students were taught about subjective experience – how the same event is experienced differently by different people and how they could change their experience of an event by feeling differently about it and how this would change the outcome. The students were also made aware of the significant role played by that their own attitudes in achieving excellence. The students were shown how this could be applied to goal-setting and were taught strategies for setting achievable goals for themselves.

A detailed description of the Record of Work can be found in Chapter 4.

Informal video discussions with students

At the end of each phase of this study a video was recorded in the form of an informal discussion which was used to gain a personal insight into these participants' personal learning experiences. As

the students were not used to participating in group discussions it was difficult, at times, to keep the conversation flowing and much of the recorded material was irrelevant, other than providing insights into some of the group dynamics. To find relevant data, it was necessary to sift through video and note key information. Johnson (2005, 68) recommended not trying to get a verbatim transcript of this type of discussion or conference. The notes made from the videos were used to enhance and enrich the classroom observations made by the researcher.

Of particular interest during these sessions was data which would inform the development of the interactive online resources. With the advantage of immediate feedback, this form of data collection was especially useful for clearing up minor problems in the resources themselves, which were sources of frustration for the students. Once one of the students had aired their opinion others quickly followed suit. This flood of information would have been difficult to record as notes. As the session was recorded, however, it was possible to return to the recording as many times as necessary.

3.5 Analysis of the Data

This study investigated student engagement with interactive online learning resources in a blended learning environment. A combination of qualitative and quantitative data was evaluated to compare changes of attitude and student engagement. This allowed the students who benefited the most from an online environment, and those who benefited the least, to be identified. In both cases the qualitative data was critical to explaining the key observations of this study (Yin, 2009).

Quantitative Data

Data from the Ministry of Education (MoE), the Statistics New Zealand 2006 census, the Tertiary Education Commission (TEC) and the students' Year 10 Assessment Tools for Teaching and Learning (asTTle) results was evaluated to compare student ethnicity, gender, and school decile and expected academic potential with New Zealand averages.

Student results were then analysed to show individual student achievement for each Unit Standard. Achievement for a particular Unit Standard was shown as a percentage on a column chart overlaid with scatter charts, showing the previous year's asTTle results and the overall attitude grade for the year as it appeared on the students' report cards. In all of these charts, the students were sorted by carpentry class, then by their 2009 Year 10 asTTle literacy and numeracy results. This enabled a direct comparison from one chart to the next of a particular student's performance in any given activity or unit standard.

After an individual analysis, the students were regrouped according to their average achievement for a particular type of activity. This type of comparison tended to even out the spikes and troughs of a student's performance and reveal overall trends and student preferences for a particular type of activity. Here too, the asTTle grade and attitude grade were tracked for each individual student.

The types of activity were then compared to ascertain which type of activity in which environment encouraged the greatest student engagement. The students were then regrouped according to their achievement in the course (**P**ass, **C**lose, **F**ail). The four students in the "close" group were working at a standard which would have made them eligible to be awarded the BCATS Certificate for this level, had they not failed to complete one of the compulsory unit standards in the course. The students who were labelled as having "failed" the course, making them ineligible for the BCATS Certificate, had two or more Unit Standards that were incomplete or not attempted. These data were sorted according to whether the student had passed the course, and then for average achievement in the type of activity. The data was overlaid with the students' individual asTTle results, their overall attitude grade for the year measured against lines indicating a datum of the school average asTTle results and the minimum expected attitude grade. In addition, the student codes were expanded to show the students' asTTle level (**H**igh, **A**verage, **L**ow), their attitude (**H**igh, **A**verage, **L**ow), ethnicity (**M**aori, **P**akeha, **O**ther European) and whether they had passed the course or not (**P**ass, **C**lose, **F**ail). Students who had been identified by the school as having learning difficulties were marked with an asterisk.

Qualitative Data

The qualitative data in this study were also analysed to explore the researcher's perceptions of student participation in a range of classroom and workshop situations during the year.

Field notes formed the bulk of the qualitative data collected. As an open form of observation had been used, it was not immediately obvious how the data should be coded. The field notes were first put into a spread sheet containing the timetable of the two Carpentry classes to put the entries into the correct order and time-frame. The entries from the teacher's reflective diary were then entered into the same spread sheet.

Comparisons between student behaviour and their achievement when working in the various learning environments and situations were made between entries and relationships sought which would explain and lend meaning to the quantitative data in the light of the research questions and the seven points from Table 6 used to guide the observation.

The data from the Informal Video Discussions was extracted directly from the video. The students' perspectives regarding their work with the online resources were extremely useful. This feedback was then used for the further development of the interactive online resources.

3.6 Validity of the Data

While internal and external validity are very important in experimental research, other understandings of trustworthiness are important in action research. Pine (2009) discusses validity as triangulation, proposes 12 validity criteria related to research as inquiry in non-experimental settings, and explores generalisability in action research.

Triangulation: In this study the data gathered by the research instruments were designed to provide different understandings of the ways the students reacted to the teaching resources. Observations and discussions with the students were recorded and teacher reflections documented. The student results for the unit standards were also recorded and subject to external moderation and review as part of the normal school practices.

Research as inquiry: Action research deals with real life situations. Some of the validity criteria identified by Pine (2009) are addressed because the researcher as teacher ensured the wellbeing and safety of the students. The research was used to support learning and adjustments were made to the teaching where concerns were identified. In addition, the action research design was known by the head of Department and senior management in the school so that debate about the theory and practice of differentiated instruction was possible during the observation period. Due to the nature of Participatory Action Research reflective and critical dialogue was not only generated, but also encouraged among the participants in the study.

Generalisability: Yin (2009) noted that just as a science experiment is seldom carried out in isolation to verify its reliability, even small case studies are rarely carried out in complete isolation and are usually based on similar studies and literature. This case study contributes to knowledge on student engagement in blended learning environments and is particularly relevant to the on-going development of understandings of teaching and learning in the school. It was carried out in a unique situation with two classes of students taught by one teacher in one year. Although the participants represented 76% of the carpentry students in the school, and the students were representative of the school population, the study cannot make claims about how the teaching resources might be used in other settings or by other teachers.

Ethical Considerations

Ethical clearance was sought and approved by the University of Canterbury Ethical Clearance Committee. The approval form may be found in Appendix A. Appendix B contains one copy of the parent and student consent forms and the Memorandum of Understanding between the researcher and the school.

This was a real life study of real people who, in the eyes of the law, were minors. Permission was sought both from the participants and the senior management of the school and the parents of the participants. Participants were not named and their identities were protected by assigning each a number. The school and exact locality have also not been named.

The study findings were not evaluated until the final grades for all students were finalised. This ensured that assessment results were not biased by student participation or non-participation in this study.

Summary

This study examines student engagement in a blended learning environment, with the aim of developing interactive online resources to improve student achievement. A case study allowed the observation of the participants in a real life situation. The cyclic nature of the study enabled the continued development of the interactive online resources and their evaluation during the study. The data collection methods enabled qualitative and quantitative data to be collected from a variety of sources allowing triangulation of the data to increase the internal validity of the study. The sample group was identified as being representative of the wider population which, combined with the multiple data sources, adds to the validity of the study. The following chapter presents the findings.

Chapter 4. Findings

Introduction

This chapter is structured into two sections. Firstly, a qualitative case study of my high school Carpentry students in 2010 is presented. Figure 3 in Chapter 3 shows the timeline of the study. Data from observations, the teacher's reflective journal and video discussions with the students is presented, showing student engagement and student/teacher interaction in the online learning environment with the interactive resources and during the period where no online resources were available due to a server crash. There is a brief summary of the findings at the end of the section.

Secondly, the quantitative data from student results is presented. The findings are presented by unit standard and are separated according to the delivery method. The results on traditional paper resources are presented first followed by the results in an ICT enhanced classroom environment. Finally, student results using the interactive online resources are presented. The results from the different delivery methods are then compared and summarised.

4.1 Qualitative Case Study - Implementing a Blended Learning Environment in a High School Carpentry Class

Overview

The decision to introduce interactive online resources and create a blended learning environment in the school workshop/classroom to teach Carpentry theory was taken to address several problems, including the students' lack of engagement with paper resources.

While the BCATS course was designed for secondary school students, it contained considerably more theory than the Elementary Construction course which it had been designed to replace. This became a barrier to success as many students chose for its practical content. Poor hand writing and presentation skills often resulted in students doing nothing rather than risk embarrassment by handing in poorly presented work. Those with poor reading skills or reading disabilities were disadvantaged when faced with large amounts of reading needed to find the information necessary to complete a worksheet or activity. The fascination of many students with modern communication technology was utilised to encourage student engagement. Students could exploit the search, spell-check and presentation facilities offered by this technology, thereby improving performance and gaining better results in Carpentry theory.

4.1.1 Teaching using interactive online resources

The students reacted positively to the introduction of the online learning environment (OLE). In the first two weeks while the student and parent/caregiver consent forms were being returned, the OLE was used to present the theory which the students would be using during the observation period.

The one-off time investment to set up the OLE with the required resources was more than off-set by the convenience and ease of delivery in the classroom. A data projector was used to display the OLE and the theory exactly as the student would see it when working in the computer pod or from home, eliminating the need to provide extra instruction for the OLE and removing any later confusion regarding student access to the learning resources.

During the presentations the students were far more focused than they would have been for an explanation of the equivalent paper resources. The lesson was transformed from a lecture with written notes to a guided tour of the online environment showing where to find resources and suggesting procedures for the students and their work. This approach encouraged the students to ask more questions about the learning environment and how to navigate through the site than would otherwise have been the case. These questions were often answered by other class members, which created a proactive, student centred learning environment.

It was obvious that student engagement with the teaching resources increased when they were displayed with a data projector as opposed to when they were written on a whiteboard and less time was required with the back turned to the class. Both of these factors sped up delivery of the theory and reduced classroom management problems, which changed the dynamics in the classroom so that more time could be spent responding to the students' enquiries. The role of the teacher increasingly became one of facilitation rather than one of lecturing. Great emphasis was put on helping the students understand the process of learning, setting their own goals, and understanding how decisions they made could influence the results. The format of the students' daily Record of Work (described in the Methodology) was developed to underpin this process.

Preparation is always important for a teacher and in an online environment where the work is accessible at all times, it became doubly important. As a result, every part of the theory for the current Unit standard had to be pre-planned and prepared so that it was ready and available for immediate use.

The students quickly noticed how detailed the instructions were for the online environment and commented on this (Reflective Journal entry 19/02/2010). The primary reason for this attention to

detail in the instructions was so students could access and use the resources from home without teacher supervision. This attention to detail in instructions was applied to other areas such as the computer animations for the practical projects. This detailed preparation resulted in the teacher spending less class time giving instructions leaving more time to answer questions, resulting in greater interaction with the students than previously experienced when using the BCITO paper resources.

The computer animations showing the construction process for each of the practical projects allowed students obtain information by watching the data projector. Although animations contained the same information as the instructions written into their books, the students preferred the clarity and convenience of the animation. With the aid of the 3D model in the animation, many found that the next step in their project could more readily be visualised. Once the students had become accustomed to referring to the animation first the amount of time used answering repetitive questions about procedure was reduced.

During the year, it became clear how teacher-dependent many of the students were, especially when required to link different theory topics, or when implementing theory in their practical work. Many would not watch or listen and just "switch off" during group instruction. This was evident during questioning directly after a demonstration or lesson. It was not possible, however, to provide individual tuition to fifteen or more students during a one hour lesson.

At one workbench, which included students 2-16 and 2-17, none of the students had referred to their written instructions. When questioned, the students' answers quickly revealed that they did not relate the written instructions in their books to their practical work. It had also not occurred to them to ask for help at the neighbouring workbench where two of the top students (2-02 and 2-04) were working.

Q: (Teacher) Why didn't you ask XXXX or XXXX to help you? They are almost finished.

A: (Student 2-16): Ohh….. dunno……. Yeah, but they're not the teacher…. (Reflective Journal entry 26/03/2010).

Student collaboration, evident during work in the computer pod, was almost non-existent in the workshop among the slower students in either of the two classes when working on their practical projects. These students did not watch the faster students to learn how to do a task, rather, they waited passively for the teacher to notice they were not on task. They appeared conditioned to the belief that valid information could only come from the teacher. This problem was effectively addressed by the

use of the computer animations, which were accepted by the students as a substitute for teacher intervention. The students were then able to inform themselves unobtrusively and without assistance.

To teach the Instrumental Drawing unit standard (U.S.7502), a web-cam and data projector were used to display the drawing demonstrations on a screen. This enabled difficult techniques to be recorded and replayed to assist slower or off-task students to catch up, while faster students were able to continue with their work under teacher supervision.

It had been noted in previous years, that many students found it difficult to relate the drawing techniques demonstrated on a whiteboard to their own work and the equipment they were using. The use of a camera allowed the demonstration to take place using identical equipment to that used by the students, removing the abstraction of the whiteboard while displaying the demonstration from the same perspective as the students saw their own work while sitting at their desks.

Advantages for the teacher:

a. the demonstration could take place facing the class maintaining teacher eye contact with the class
b. the faster pace of the lesson reduced the level of boredom that faster students experience when having to wait for slower students to catch up
c. the replays could help the slower students and those who were off-task during the demonstration while the teacher assisted others
d. more time was available to assist students who genuinely struggled with the work

These factors reduced classroom management problems and, although overall achievement improved only slightly, the quality of the work had improved. Notably, the blended learning environment reduced the delivery time of this unit standard to one week compared to the three weeks required in previous years. This time was then available for other theory work and practical projects, benefiting both the students and the teacher (Reflective Journal entry 10/09/2010).

4.1.2 Student Engagement with Interactive Online Resources

Obvious differences were observed in student engagement and achievement when the students worked with the interactive online resources developed for this course as opposed to the usual BCITO paper resources. Even when the conversations in the class turned to rugby (Reflective Journal entry 05/03/2010), which would have otherwise distracted the students to the exclusion of everything else, work continued with most of the students gaining high marks. In addition, as many students were already familiar with the OLE, peer learning naturally occurred during the initial sessions in the computer pod, with students learning from each other at a rate faster than they could have been taught by a teacher alone. The collaboration between students, in small groups or pairs, resulted in a wide variety of strategies being applied to complete the activities and worksheets in the fastest possible time with many students attaining 100% for their work. The peer learning and collaboration amongst students enabled a move away from the teacher-centred teaching style previously used in this course, to a student-centred learning style. Prior preparation and planning were extremely important. Instructions had to be clear and concise while the online resources needed to be readily available for the students to work at their own pace. Depending on their personal learning preferences, the students chose different activities to start with. The interactive online resources were self-marking which motivated the students to work steadily through the activities with each success. Most of the time, the teacher was free to observe, deal with technical difficulties and offer advice on strategies for working efficiently with search-engines and the various sources of information. Unlike the paper resources, where the students were often satisfied with just filling in the gaps, frequently turning to the teacher for answers, the students were success oriented when using the online resources, working until they had achieved the maximum number of correct answers possible (Reflective Journal entry 31/03/2010). The most common question from the students was: "***How*** *do I get the right answer?*"

Interestingly, once students had the information they required to continue their work, they became impatient if more information than needed was volunteered.

The need to have resources prepared and available for the students was highlighted in the final computer pod sessions for Term 1. As the faster students finished their work, they were tempted to play computer games or surf the Internet, distracting the slower students in the process. A buddy system where the faster students helped the slower students proved unworkable, in part due to personality conflicts and some antagonism between the two groups of students, while in other cases, the buddy would impatiently do the work for the other student. Sending the faster students to the workshop unsupervised was not an option. The only workable solution in this case was to insist on strict separation of the two groups, and reward the slower students who managed to finish by allowing

them to join the faster students on the other side of the arbitrary division line. This tactic motivated most of the students to complete their work. Student 1-03 willingly remained in class at interval to finish his work which had never happened with paper-based resources or his practical work. Motivation to complete the work was high and kept nineteen students occupied on twelve computers, quite an achievement in itself (Reflective Journal entry 17/03/2010).

4.1.3 A Server Crash Necessitates the Re-introduction of Paper Resources

In week one of Term 2 a server crash made the interactive online resources inaccessible. As it was uncertain how long the server would remain inaccessible it was decided that the students should complete Unit Standard 24355 on the BCITO paper resources as a precaution so that it could be assessed. The students found working with the paper resources more difficult than with the interactive online resources, and the negative attitude of most in both classes was clear. This attitude led to a lack of motivation and old habits of just copying the next best answer so that the gaps on the paper were filled in reappeared. Many students also had great difficulty with the concept of alphabetic order for anything past the first or second letter in a word. This left many of them incapable of quickly and efficiently using indexes and glossaries as they needed to read every word in an entire chapter to find an answer, making work with the paper resources slow and laborious. Often students would miss an answer due to poor reading and spelling skills.

The attitude toward paper resources was no worse than in previous years, just more apparent when compared to the engagement shown by the students when working with online resources. Old work habits were mixed with an interesting new revelation about the way students were reading their theory books.

Observation showed that one of the problems for some students using paper resources was that they seemed to concentrate their reading in about the same area of the page that they scanned when reading from a computer screen, influenced to some extent through height and posture (Reflective Journal entry 27/04/2010). While the students could scroll the computer screen and obtain the information they required, this was not possible on paper. The result was that the information outside this area of the page remained unread. Questioning revealed that several students had this problem. These students all displayed similar tendencies although they missed different parts of the information, The students seemed to be unaware of this anomaly in their reading and even when made aware of it, were not able noticeably to change their reading habits. While this observation is by no means conclusive, it would appear that for some students, reading mainly from computer screens has affected the way they physically read a page and therefore affects their ability to work with paper resources.

4.1.4 Access to the Online Learning Environment is Restored

At the beginning of Term 3 the final problems regarding access to the online learning environment were sorted. The intervening time had been used to modify the interactive online resources using the insights gained from student feedback and observation. One source of student frustration with the online resources requiring a written answer was that the self-marking feature would often mark an answer as wrong due to a small spelling mistake or a punctuation error. This problem was not easy to remedy as it was difficult to predetermine which mistakes the students would make and incorporate them into the computer's marking schedule. These questions were substituted with multiple-choice questions where more than one answer may be correct, multi-choice for questions where only one answer was required and cloze exercises where only a word or short phrase was required. This was considerably easier to develop as the answers were either right or wrong. Another major bug in the first set of resources was that the activities or worksheets contained ten to twenty-five questions. As the interactive resources could not be saved and had a set time limit, if the student refreshed the screen, ran out of time or started to make silly mistakes towards the end of the activity, they were forced to repeat the entire activity. The new resources contained only one or two questions so that if the work was lost, minimal time was required for another attempt. This also allowed for a greater variety in the types of activities that could be used and they could be better matched to the question. These alterations not only overcame two of the biggest problems for students when using the interactive online resources, but also solved a development problem for the teacher/researcher caused by the simplicity and lack of options in the Hot Potatoes development suite (Reflective Journal entry 06/08/2010).

The delay caused by the server crash allowed time to put all of the remaining resources online for the students so that the faster students would be able to continue with the next unit standard once they had completed the first one. The students switched from one activity to another, seeking out their favourite types of activity first. However, the timers in the new online resources had been set so that the activities timed-out faster which caused some frustration. However, as a result of this, some students began to inform themselves more carefully before starting an exercise (Reflective Journal entry 06/08/2010).

By Term 3 the novelty had worn off the online learning environment and some students were occasionally bored or disruptive. However, once all the resources were available, and there was greater variety in the types of activity available, most students quickly settled down to work, allowing the teacher to deal with the students who were off-task.

Each class had one student in the sample group who had completely disengaged not only from the online resources but also from the rest of the course. Both these students had the ability to succeed but appeared to be trying to set their own parameters within which they were prepared to work (Reflective Journal entry 30/07/2010). The students who claimed to be having the most difficulty were those who spent the most time complaining about the amount of work. Their claim that the work was boring was reinforced by the slow pace of their work, which made it boring for them. Moreover, the quality of their work was so low that they could not take pride in it nor have fun doing it. These students tended to set lower goals for themselves than their classmates, rewarding themselves with frequent breaks after very little work. Positive reinforcement for any work done well, was often seen as an excuse to work less during the next period (Reflective Journal entry 27/08/2010).

4.1.5 Ending the Observation Period

Overall achievement for the carpentry course remained similar to previous years, in spite of the success of the blended learning environment for classroom teaching and the interactive online resources which had encouraged extremely high levels of student engagement.

Although students often scored grades of 95%–100% when working with the interactive online resources as opposed to only 30%–40% when using paper resources, it was their failure to complete all required elements and performance criteria which prevented students from achieving the unit standards they were attempting.

Other than referring to the computer animations for instructions on the construction process of their practical projects, there was little visible evidence that students applied the theory they were learning to their practical work. Most students treated the two as separate subjects and had to be taught the same material in both environments; once as theory and once as a workshop process. Similarly, the students also failed to make the connection between the mathematics they had learned as a separate subject and the quantity calculations and trigonometry they required for the plans they had drawn and the construction sequence of their projects. These students compartmentalised learning into subjects which impacted on their ability to apply their learning across different subjects (Reflective Journal entry 17/09/2010). Notable exceptions were students 1-03, 1-08, 2-02, 2-04 and 2-08, who demonstrated active enquiry when working in the workshop and referred to plans, notes and instructions before requesting help.

Summary

By the end of the observation period it was clear that almost all students preferred working with the interactive online resources, even those who found the timer and the competitiveness stressful.

For the teacher, careful planning and a lot of up-front work was required to prepare the online environment and the interactive online resources for the students. This work was more than offset by the ease of delivery in the classroom using the online environment as a teaching aid, the self-motivation of the students during the computer sessions reducing classroom management to a minimum and, finally, the self-marking resources which saved hours of marking, reassessment and remarking.

The use of a web-cam to display and record demonstrations revolutionised the delivery of the Instrumental Drawing unit standard and was also applied in different situations; such as practical demonstrations. This technology required no extra teacher preparation other than ensuring that the components were available and worked correctly. The ability to instantly replay a demonstration and freeze the picture at critical points made explaining complex techniques quicker and easier. Classroom management was also easier as eye-contact was not lost with the class. When large portions of the demonstration were replayed for students who lagged behind, the teacher could help others catch up or help faster students complete their work. The effect was as if a second teacher was in the class.

The “second teacher” effect was equally true of the computer animations displayed on the data projector for the practical projects. Like the interactive online resources, the computer animations required one-off planning and preparation prior to delivery. Once in place, students repeating questions that had already been answered more than once were referred to the animation thus freeing up valuable teacher time to assist students who were either struggling or ahead of the class.

It had been important to ensure that the students in both classes were made aware that learning is a proactive process and that much of their success or failure could be influenced by changing their attitude. By the end of the observation, even those who did not apply the principles they had been taught to assist their learning were aware of the terminology and language of learning which provided a solid platform when discussing strategies to improve their results.

In this study the teacher was both researcher and teacher with the advantage that the students could be observed in their natural surroundings and they were mostly unaware that observation was taking place. Another advantages as a teacher, information could be accessed that may have been difficult to

obtain for an outside researcher. Because the students were well known to the researcher, even small changes in behaviour were noticeable. This intimacy with the participants outweighed the possible disadvantage that some observations may have been missed while performing other duties. The possibility of data distortion through personal bias was addressed in this study by the extensive use of student results and school records to triangulate the data.

The experience as a teacher/researcher also provided the opportunity to investigate and question the praxis and pedagogy behind the teaching and assessment for this course. This proved to be invaluable, not only for the further development of interactive online resources and the blended learning environment, but also influenced how the other theory and practical work in the Carpentry course was taught.

4.2 Quantitative Findings of Student Results

Overview

The first section introduces the participants in this study and compares them with the New Zealand population, the population in the Auckland region and the wider school population regarding ethnicity, gender and academic ability. Finally, the academic ability of the participants in the two classes is compared on the basis of their 2009 asTTle results.

The second section examines the use of the standard paper resources and student achievement when keeping a written "Record of Work", a sort of planner/reflective diary, written bookwork theory and results on printed activity and worksheets. The results here indicate how the students may have performed under normal circumstances in previous years and form a benchmark for indicating changes student behaviour and attitude when working with online resources.

The third section looks at the teaching of graphics skills. A whiteboard was used in the first unit standard to demonstrate sketching skills. For the second unit standard, video and projection technology was introduced into the workshop to assist the delivery of the demonstrations. Major differences in achievement were not apparent by comparing results; however, the blended learning environment enabled faster delivery of this part of the course than had previously been possible while achieving similar results.

The fourth section inspects student achievement and behaviour when working with the online resources developed for this study. An unexpected opportunity to compare one Unit Standard and two different delivery methods presented itself when the school servers crashed. As it was unclear how when the students could access the online resources again, the Unit Standard 24355 was delivered on traditional paper resources and again as online resources at a later date. The differences in student results between the two modes of delivery were then compared.

The fifth and final section looks at student achievement track students ethnicity while sorting the students according to their expected academic potential. The average student results are then compared in the areas: paper resources, resources delivered in a blended learning environment in the classroom, online resources in the computer pod and student achievement with practical projects in the workshop. Finally, the students are grouped according to whether or not they completed the course. A small group who failed to complete just one of the compulsory Unit Standards was also identified because all that separated some of them from those who completed the course was a single worksheet which put them very close to course completion.

Comparing the student participants to the wider population

There are several ways to measure what a sample represents. One is to take a snapshot of the sample, observe for a period of time and measure the difference. This will measure change within a group but does not allow the group to be measured against a larger population. To compare the participants in this study against the wider population, data from school records, the students' 2009 Assessment Tools for Teaching and Learning (asTTle) and statistics from the New Zealand Census 2006 were gathered and collated on the basis of ethnicity (Appendix E), gender (Appendix F) and academic achievement (Appendix G).

The sample group was comprised of 30 of the 42 Year 11 students (71.5%) taking Carpentry in 2010. Four students declined to participate while eight students failed to return a consent form. Despite a 25% difference in class size, the percentage of students willing to participate from each class was similar; 13 from 18 students (72%) the smaller class (Class 1) and 17 from 24 students (71%) from the larger class (Class 2).

Analysis of the two classes showed that they were representative of the school, the sample community and the New Zealand population who study carpentry at the level in ethnic distribution and gender. However, the academic results revealed a difference between the two Sample Groups. While Class 1 remained representative of the school population in numeracy and literacy, Class 2 had proportionately twice as many students as the mainstream school population with low Year 10 asTTle grades. This difference was most noticeable in the asTTle numeracy results which were considerably lower than those of the students in Class 1.

The students who had achieved high asTTle results were distributed proportionately between the two classes leaving Class 2 with proportionately fewer students who had achieved average results. Overall, 77% of the participants in Class 1 had an average to high Year 10 asTTle result compared to only 53% of the participants in class 2. At the other end of the scale, 47% of the participants in Class 2, nearly half the class, had a below average Year 10 asTTle result in 2009 as opposed to only 23% of the participants in Class 1.

The breakdown of the distribution of the participants of both classes according to their 2009 asTTle results can be seen in Table 7. The differences in the classes allowed the observation of two dissimilar groups under similar teaching and learning conditions.

Table 7: 2009 Year 10 asTTle result distribution of the study participants in the two Sample Group classes

asTTle	High	Average	Low
Class 1 = 13 Participants (from 18 students in the class)	3 (23%)	7 (54%)	3 (23%)
Class 2 = 17 Participants (from 24 students in the class)	4 (23.5%)	5 (29.5%)	8 (47%)
Combined Totals of Participants	7 (23%)	12 (40%)	11 (37%)

Interventions

A logical extension of the school policy teaching students to think about their learning (Ako) was to teach the students about the Neuro-Linguistic Programming (NLP) principle of being able to control outcomes by a deliberate change of attitude. Many students were open to these ideas although few took them to heart. A notable exception was Student 2-08 who remained after class one day and excitedly relating how he had applied the positive thinking NLP techniques he had learned in class to obtain his restricted driver's licence. His parting comment was: "*That NLP stuff really works*!" (Reflective Journal entry 02/03/2010)

Discussing the nature of learning in class made all aware of what the study was trying to achieve and the pedagogy behind it. This proved a useful vehicle and provided the necessary vocabulary and concepts when talking with individual students, even those who did not attempt to apply the principles of NLP to their learning.

By Week 2 in Term 1 (Reflective Journal entry 12/02/2010) one group in Class 1 was already showing a lack of respect towards any type of authority and were not prepared to listen, preferring instead to allow the antics of the group to distract them. This group included the student participants 1-12 and 1-13. Attempts to separate these students within the class created more disruption than leaving them together and the option to shift the students to another class was not available. It was decided to leave the students as a group and treat them separately as a sub-group of the class, which allowed the students' attitude to be directly targeted or isolated as the need arose. It was of interest to find out if these students could be motivated to change their attitude or if factors such as the peer pressure within the group, poor work habits, low expectations and low self-esteem were already insurmountable problems for them.

The strategies used to address the issues within the group were:

1. Additional explanations once the rest of the class was working. The intention was to treat the group as a very small class where attention to individual students and individual needs was possible. This was a necessity because many of the students rarely listened during group instruction and would not have known what to do otherwise.
2. Formative feedback and encouragement was given where necessary or deserved. Discussions with other teachers revealed that these students rarely, if ever, received positive feedback in their other classes. The intention was to try to break the cycle of negative feedback and give the students positive reinforcement when they worked well.
3. Time was taken to raise the students' awareness about how their attitude affected their outcomes. This was one of the central themes of the basic NLP principles being taught to both classes. The students were shown how they had a choice about how they felt about things and that a change in attitude could change their outcomes and that this was within their control.

It was decided that extra time would be invested in these students during term 1. Should the students still be struggling in term 2, they would be treated similarly to other struggling students. By term 3 the students who genuinely needed help would be assisted but now the students who were working towards course completion would receive the extra attention they required to finish their work on time.

Although the students enjoyed receiving positive feedback, they would often stop working once they had received it. These students and others in both classes who were struggling appeared to be satisfied with a lower level of success before rewarding themselves with a break (Reflective Journal entry 04/06/2010). As a result, any encouragement that they had done well in their practical or written work or a achieving a high score with the interactive online resources made them feel as if they had fulfilled the requirements of the lesson which encouraged them to stop working. In the practical setting, positive feedback could be withheld until the end of the lesson but there did not seem to be any noticeable difference if the students felt they had met their own expectations.

The discussions with the students about attitude (Reflective Journal entry 15/03/2010) revealed an underlying dependence on the teacher for direction. It also revealed reluctance by group members to accept responsibility for their own learning and outcomes. The spokesman for the group (Student 2-12), by default, would often attempt to twist the logic of the argument. Once the group grew tired of the debate or had run out of arguments the standard retort seemed to be:

"Yeah… But if we fail then that means you are a bad teacher…" (Student 2-12 and others on various occasions)

Results showed no overall change in attitude throughout the year from these students. Occasionally, however, when these students worked well, their engagement was high. Their endurance and tenacity to learn something thoroughly and get things right was lacking, more than ability.

Student Engagement

There was an immediate positive response from the students to the online learning environment and the interactive resources. A video taken at the time showed all students on task, working alone or in pairs. This was an interesting change in student behaviour, as previous experience had shown that students were often tempted to surf the Internet rather than work on their theory. The difference appeared to lie in the nature of the exercises.

The computers in the school are often used for assignments where the students search for information, photos and clipart. When a brief is very open-ended and lacking direction, students often surf the internet randomly, distracted by the many sources available. The 2008 pilot study showed that many of the students in this study had only superficial abilities with search engines and often lacked the skills necessary to search for specific information, and to evaluate what was relevant. Much of the information found by the students was discovered by chance, through random surfing and clicking on links that caught their attention.

The resources developed for this study firstly ensured that all of the information required for the students to complete their tasks was contained within Ultranet, the online learning environment or directly accessible through a link, effectively removing the need to surf the web and providing strict parameters within which any searches could be carried out – usually within a specific document.

Most school projects have a final deadline and many larger ones signpost student progress to encourage a constant work rate. However, students often take a "just-in-time" approach to these deadlines, rushing to complete their assignments over night after long periods of little productivity.

A timer integrated into the online interactive resources gave students an immediate timeframe for each individual task or activity. If the student "timed out" they would have to start afresh; this encouraged a consistent work pace. The timer also added competitiveness that had otherwise not been present with students vying with each other to complete their work with the highest score in the shortest possible time. At the end of term 2 (Informal Video Discussion 30/06/2010) the students were

asked to comment on this aspect of the interactive online resources. In Class 2 there was unanimous agreement that the competitiveness was a positive thing.

Student 2-08 commented: *"Typing is easier than writing… the timer makes it hard though, but it's a challenge!"*

Student 2-04 added: *"You would never repeat and revise answers on paper but you do in Ultranet to get a high score."*

In Class 1, some students had mixed feelings. Twelve of the sixteen were positive. There was general agreement that it made working on the computers more fun and a few commented that it helped them achieve better results. The students felt that working on the computers was easier than writing – even when the question and answer were identical. In answer to the question "*What made it [Working with the online resources] more fun?*" Student 1-03 replied: "*It was easier*."

Student 1-11 added: "*It is not like just copying from the book.*"

At one bench, which included students 1-03, 1-08 and 1-09, students felt that the atmosphere was too competitive. Student 1-09 commented: "*It makes you do the work more than once.*…" Student 2-09 in Class 2 did find working to the timer frustrating (Observation 29/07/2010) although he never complained about the competitiveness.

A third difference to the assignment type approach was that the interactive online resources provided immediate feedback without teacher intervention. Although the teacher often provides formative feedback during computer sessions, marking and a final result usually occur after the students have completed, printed and handed in their work as they would with traditional paper resources. This instant feedback not only encouraged the students, but with the resources already marked, there was a significant reduction in teacher load at this end of the process.

Student assessment results and observations

The following sections look at student results in a range of situations. Firstly, the student results using paper resources in both a traditional classroom situation and a blended learning environment were compared. Next, the results from the online learning resources developed for this study, followed by the students' practical work in the workshop, were analysed for trends in student achievement.

Because great reliance is often placed on asTTle results to predict academic achievement and identify at-risk students, the results were separated into classes and sorted according to their Year 10 asTTle results. Firstly, this would show whether this assumption is well founded and secondly, it allowed

individual students to be tracked from one set of results to the next, giving a clear picture of student achievement in a variety of situations. The data was also displayed against the overall attitude grade for the year. Changes in achievement were used as indications of changes in student attitude.

Key indicators in the results

During the study, it became evident, through observation that certain combinations of asTTle, attitude and achievement results tended to indicate certain student characteristics. To aid analysis, some of the most noticeable combinations noted during observation have been recorded in Table 8.

Table 8 : Combinations of Year 10 asTTle results, overall 2010 Attitude grades and achievement during individual tasks during the course, used as indicators of possible student characteristics regarding interest and ability in Carpentry.

asTTle	Attitude	Achievement	Indicated student characteristics
High	High	High	Interested and engaged with ability in this area of the subject or task.
High	Average/Low	High	Natural ability or increased interest in this area of the subject or task.
High	High	Average/Low	Lack of interest in this aspect of the subject or task.
High	Low	Average/Low	Laziness or total disinterest in this area of the subject or task.
Average	High/Average	Low	Lack of interest in this aspect of the subject or task.
Average	Average/Low	High	Natural ability or increased interest in this aspect of the subject or task.
Low	High/Average	Low	Genuine learning difficulty
Low	Low	Low	Poor work ethic or learning skills

The table of indicated characteristics is based on informal researcher observation, aided by eight years teaching experience. It is by no means conclusive, but the correlation between student grades and observable characteristics was consistent enough to assist in monitoring changes in student attitude during individual activities and tasks.

In this study only four of the participants were identified by the school as having genuine learning difficulties: students 2-13, 2-15, 2-16 and 2-17 (Class 2), identified with an asterisk in the charts that follow. Three others were identified as having normal ability but extremely poor work ethics: students 1-12 and 1-13 (Class 1) and student 2-14 (Class 2).

4.2.1 Student Results using Paper Resources

Student Record of Work

About this task

The Record of Work was initially introduced to this course to replace traditional school assignments with an activity more closely resembling the paperwork demanded of Carpentry apprentices as compulsory evidence of their practical experience in partial fulfilment of the requirements towards the New Zealand Certificate in Carpentry. The Record of Work format evolved to comply with measures introduced by the school to ensure that students were made aware of the "Learning Intentions" and "Learning Outcomes" for each lesson by having the teacher write these on the board at the beginning of the period. The intention was to enable students to assess their own progress, gauge their own success as well as giving teachers a means of directing the focus of the lesson. While this one-size-fits-all approach may work with mathematics, English or science where the students often work on the same part of a topic at the same time, in a practical subject, the students very are often at different stages of a project or working on different projects concurrently, effectively making it impossible to write "Learning Intentions" for the whole class. Having each student write their own Learning Intentions (Goal) and Learning Outcomes (Achievement) fulfilled the school's requirements while ensuring that each student was aware of their own individual progress. The record of work was taken step further with the addition of a third column requiring the students to make a reflective analysis (Analysis) of the outcomes as a plenary of the lesson which informed the goal setting for the following lesson. The entries for each day were written in columns, side by side. The students were given 1–2 minutes per column. This was to encourage students to set concise goals and to provide them with an overview of their progress at a glance. Figure 10 on the next page, shows an example of a student's work. Table 9 on the following page, shows the marking schedule used to evaluate the three columns in the Record of Work.

Figure 10: Example of a Student's Record of Work (Student 11 Class 1)

Date	Goal column	Achievement Column	Analysis Column
29-3-10	to complet chiseling & get up to drilling out.	finshed chizling, drilled out and got most out of all 3 holes.	next time I want to clean them out.
31-3-10	I wanted to clean out my wood and cut into the 3 peaces.	ended up at the computer and got 99% on work sheets.	99% good efot.
1-4-10	to clean out wood.	Cleared out 2 Holes.	next time I need finsh.
19-4-10	To start to cut my wood	cut all my wood and now fiting it.	to fit it altogeth next lesson
22-4-10	-sketch a saw horse stool in isometric (full page) -start copying the intructions details for sawstool project.	copyed out steeps 1,2,3 as well a sketching out a saw stool (in isometric)	it taking so lon
26-4-10	to work on theroiy work booklet.	completed activity 1, 2.	got it to it.
27-4-10	to atemted finsh steps	got half way	improve sketch
28-4-10	to finish all the steps.	only got up to the fitting the cleat step	& class talks to much. Jam

Table 9: Marking schedule for the evaluation of the three columns of the daily entries in the student Record of Work.

Column	Marking Criteria
Goal	1. Outlining the intended progress for the lesson. Did the goal fulfil the following criteria? **S**pecific – e.g. "Cut and fit saw stool legs" not just "continue with saw stool". **M**easurable – Would the student know if they had achieved their goal? **A**chievable – Could the task be done with the means available? **R**ealistic – Was the goal within the student's own capabilities? **T**imely – Was the sequence of events correct?
Achievement	Documentation of actual progress for the lesson. Was this an accurate representation of the actual progress throughout the lesson?
Analysis	Looking at the reasons for the success or failure of the goal. Especially important if the goal and actual achievement differed. - Were links made between the Goal and actual Achievement? - Were reasons given for any differences between the Goal and Achievement? E.g. too many students wanting to use the same machines, having to start again because of a mistake or even just underestimating the amount of time it would take to complete the job. - Was the student being honest with themselves as to how much they could have achieved e.g. taking note of time wasted talking; standing around not knowing what to do and not asking? - Were strategies for future learning identified?

The Record of Work, although a compulsory part of the course, was also intended to provide the students with formative feedback and assessment. By writing their own goals and assessing their achievement the students learned a lot about their own capabilities and how to set themselves achievable targets. To do this they had to learn to take the workshop environment into consideration, looking at aspects such as the availability of tools and machinery, assessing their own competency and how much help was available from the teacher or fellow students. Throughout the term the quality of the entries were randomly inspected and the students quizzed on their understanding of the process and pointers given to improve their entries. At the end of each term, the books were collected and feedback was given to assist the student in developing their goal-setting skills. Each term the criteria for attaining a satisfactory grade were toughened to reflect the level of work that was expected of the students as the course progressed (Table 10.)

Table 10: Expected increase in the regular entries in the student Record of Work as the school year progressed.

	Goal	**Achievement**	**Analysis**
Term 1	Regular entries showing individual improvement	At least occasional entries of own volition.	At least the entries from teacher-led activities.
Term 2	Regular entries	Regular entries showing individual improvement	At least occasional entries of own volition
Term 3	Regular entries	Regular entries	Regular entries showing individual improvement

As the entries were very short, it was not expected that each entry would fulfil all criteria, but that the criteria would be reflected in a picture created by a series of consecutive entries. With this record, the students could look back at their progress and identify where they had problems, where they wasted time (if they were honest enough to write it down) and also find encouragement in what they were able to do well.

Observation

For about half of the students, filling out the daily Record of Work quickly became a routine both at the beginning and at the end of the lesson. From the remaining 50%, many of the students would only fill in the Goal but would attempt to avoid the Achievement and Analysis sections or try to cheat by

filling them in at the start of the lesson. One or two students tried to avoid writing anything at all and when they did, there was no attempt made to adhere to the expected format.

In spite of the school-wide initiative to make students aware of their learning and provide a means to assess their own progress, most students struggled to think in an analytical manner about their own learning or make measurable goals which would give them a clear path to follow. The biggest issue for many of the students seemed to be the lack of motivation to improve their grades or change their attitude.

The student who fared best were those who, at first, mechanically followed the format until a picture of their progress began to appear. As this picture developed, so too did their understanding of what was required. These students were also more willing to seek and accept advice than the others. Another reason it was easier to give assistance to these students was that it was possible to discuss good and bad points on the students' own work which usually led to a greater understanding of what they needed to do to improve. Students who had done little or no work had to try and understand examples given from a teacher's viewpoint as their own work was either non-existent or bore little or no resemblance to what was required. Even examples of work from other students often did little to improve their understanding as the core of the problem lay with their lack of engagement with the activity rather than their ability to carry it out.

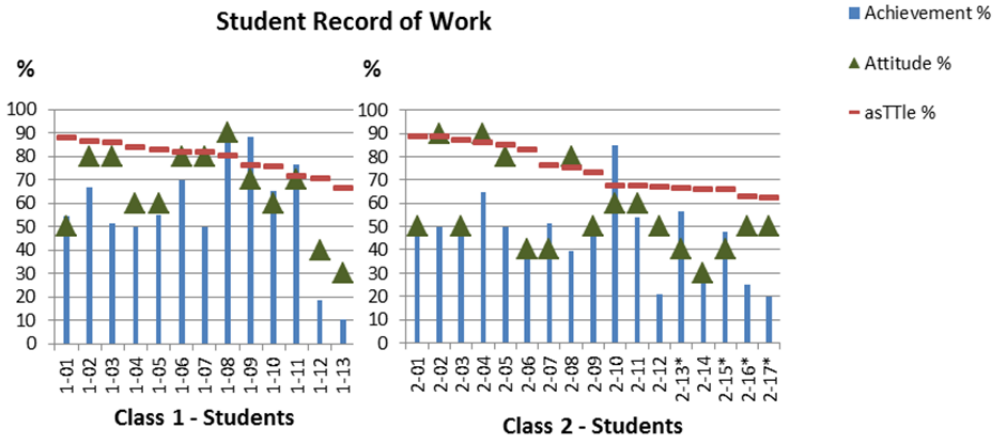
Results

Being intended as formative assessment, the students received a comment with no grade. However, in the teacher's records a grade was given to maintain an overview of student progress and to identify students who were struggling or not performing for some other reason. The grades were assigned each term so that an average student, fulfilling the above criteria to a reasonable standard would achieve 50% or better. It can be seen from the overall results in Figure 11 that most of the students in Class 1 more than achieved the expected level of work, giving the class a mean of 57%. In Class 2, only two thirds of the students achieved a satisfactory result, leaving the class with a mean of 46%.

Figure 11: Results overview for the students' Record of Work. The results are measured against marking criteria where the majority of students would be expected to achieve between 40% and 60%.

To identify individual student performance, Figure 12 sorts the students by class and asTTle result. On this scale, the asTTle results shown as being between 70% and 83% are what would be considered average results. The overall grade and overall attitude for the observation period is shown and gives a clear indication of the students who were making an effort to complete their work to a high standard and those who were not.

Figure 12: Student Record of Work - Results sorted by class and Year 10 asTTle results.



In Class 1, students 1-12 & 1-13 made no attempt to keep a record of work. Anything they wrote was either scribbled over or torn out within a short space of time. When questioned, their answers made it apparent that they had resigned themselves to failing the course and were in the process of convincing themselves that any effort on their part was futile. During discussions, these students displayed the defiance and “attitude” that is so often mistaken for pride by students of this age. Results showed the attitude of these students changed from task to task which belied their bravado. In some activities

these students took obvious and genuine pride in doing well; it was written activities such as writing the Record of Work and copying instructions that seemed to aggravate their non-engagement.

In Class 2, the situation was somewhat different. Student 2-06 had the ability to achieve satisfactory results in this task. When questioned, he showed a good understanding of what was required. In this instance, the student freely admitted that the poor result could be attributed to laziness. Student 2-08 worked hard and made regular entries in his Record of Work. Although his goal-setting and record of achievement were well written and reasonably complete, this student made very little use of the "Analysis" column which was a requirement for Term 3 to achieve satisfactory results. Student 2-14 had a poor attitude towards this task but without the bravado of students 1-12 & 1-13 in Class 1. He was far more content to quietly "slip under the radar" to avoid doing the work. Students 2-12, 2-16 & 2-17 genuinely struggled to grasp the reflective, self-analytical concept behind the Record of Work, an example of which can be seen in Figure 13.

Figure 13: Example 2 of a student's Record of Work (Student 2-12) showing the lack of reflection in the daily entries.

Date	Goal column	Achievement Column	Analysis Column
16/10/10	Learning how 2 do order forms.	Learnt 2 do order forms?	
~~18~~ 18/10/10	Continue on track.	Stuffed da cleat unscrewed.	need 2 recut cleat.
24/10/10	I ~~Thrill~~ Hope fixed my cleat?	Didn't fix my cleat	Get checked next time
25/10/10	continue		

Some students struggled with written work in presentation and their ability to express themselves in words. As the dates show, Figure 13 is an excerpt from late in the year and showed no improvement from the first entries. In spite of the lack of analysis in the entries, the record was still useful to the student as an indicator of progress, just in a more limited way as it gave no real indication of what

actually occurred except that overall progress was recorded after a fashion and it could be seen that the student was struggling in both his written and practical work.

Student 1-01 (Class 1) and Students 2-01 and 2-03 (Class 2) were let down by poor attitude and a lack of engagement with the task. They had the ability to produce very good written work when they wished but. These three students often put in just enough effort to pass and to avoid trouble or as they put it: “Just cruising through.”

Figure 12 also shows that although many students received satisfactory grades, the students with lower asTTle results in Year 10, as a group, tended to be the ones to struggle with this task regardless of their overall attitude. It can also be seen in Class 2 that the overall attitude of the weaker students tended to be lower than those with higher asTTle results. This, coupled with low self-esteem, gave the students little chance when it came to improving themselves. Generally, they required the most encouragement and were also the most likely to give up when faced with a challenge.

4.2.2 Unit Standard 12927 Identify, Select, Maintain and use Hand Tools for BCATS Projects

The theory in this Unit Standard is comprised of five activities (question sheets contained within the BCITO resources for formative assessment) and one worksheet (a question sheet from the BCITO resources used for the summative assessment of the theory for a unit standard). The activities are intended to deepen student understanding of the theory and do not count towards the final assessment of the unit standard, however, the students were not made aware of this to ensure that they applied themselves equally to all tasks before attempting the worksheet. In addition, there was a practical component to the unit. Three projects were made where the students demonstrated their knowledge and ability with a variety of hand tools in different situations. For this study, the theory activities and worksheet were separated from the workbook and stapled together into a booklet. The students were given two periods to complete the activities, similar to the time allowed for each of the online resources developed for the study. This meant that they had access to the same resources as in the online environment, just on paper. They were also allowed to work collaboratively if they wished and were guided in strategies to find valid information by the teacher. The students were then given one period to complete the worksheet, working on their own using the same resources. The activities and worksheet were then marked with written feedback and the students who had not achieved the 90% minimum required for the worksheet were then given the opportunity to correct their answers. Finally, students who had achieved at least 80% after correcting their answers were tested verbally on failed questions and a range of related topics.

Observation

The students had already been introduced to the idea that they would be using computers for some of their theory and had seen examples of the online learning environment. As a result, many students protested against having to do these activities and worksheets on paper stating that they far preferred the online interactive resources although they had not yet had the opportunity to ascertain if this was true. Certainly, the expectation that they would be working on computers had an impact on the students' general attitude toward working on paper even though they had been warned that some of the theory would be completed this way.

In Class 1 a large number of students spent extended periods of time off task and engaging in disruptive behaviour. Another large group at an adjoining table willingly allowed themselves to be distracted, encouraging the disruptive group. The result was that both groups produced little or no work at all. A large amount of time was required for classroom management, leaving little time to help the students who genuinely needed it. The students used very few strategies to find the correct information in the paper resources. Usually the answer from the first student who looked as if they had guessed the correct answer would be copied by the rest of the group without checking the context or content of either the question or the answer. Some students satisfied themselves with only copying part of an answer, once again, without checking for correctness or whether the part of the answer had anything at all to do with the question.
Students 1-02 and 1-03 in this class opted to work on their own, ignoring what was going on around them and were the only ones to finish all of the activities.

In Class 2 the students were more willing to settle down and work. There was one group of students that produced little or no work but they did this without disturbing the rest of the class. Once again, the strategies used to find the correct answer were extremely limited for those students who were copying the answers off each other. As soon as one of the students in a group started to write, the others in the group would stop looking through the resources and copy his answer. Four students (2-02, 2-04, 2-05, and 2-08) in this group opted to work on their own. As a result, these students had fewer distractions and were the ones to complete most or all of the activities to a high standard. Student 2-10 and 2-11 opted to work together. Although these students finished all of the activities, the fact that they worked together possibly made them less cautious about finding the correct answer before writing it down which impacted on their results.

Results

In Table 11 and Table 12 the lack of engagement with the written activities in both classes is obvious. Three of the six students who did not attempt the activities at all were absent on the two occasions the activities were presented in class (Students 1-08 and 1-11 (Class 1) and student 2-07 (Class 2)). However, these students did not use any of the opportunities offered to them to complete the activities at a later stage. As the activities were optional, it was still possible for them to pass the unit standard without these results but as the students were not aware of this at the time, their lack of engagement was disappointing.

Table 11: Results from theory when studied on paper by the students in Class 1 - Sorted by the number of completed activities, their average result and their attitude grade. Yr. 10 asTTle results and worksheet result are also included. The highest and lowest grades have been highlighted.

	Unit Standard 12927 Hand Tools Theory					
	asTTle High/ Average/ Low	**Attitude** High/ Average/ Low	**Student**	**No. of Activities Completed From 5**	**Average Results in %**	**Worksheet Result in %**
Class 1	**H**	**H**	**1-02**	**5**	**94**	**100**
	H	**H**	**1-03**	**5**	**91**	**100**
	L	**L**	**1-12**	**4**	**36**	**20**
	A	A	1-09	2	93	100
	A	A	1-05	2	78	90
	L	**L**	**1-13**	**2**	**68**	**30**
	H	L	1-01	2	57	100
	A	A	1-10	2	50	90
	A	H	1-07	1	85	100
	A	H	1-06	1	66	100
	A	**A**	**1-04**	**1**	**66**	**30**
	A	H	1-08	0	0	95
	L	A	1-11	0	0	90

Students 1-02 and 1-03 in Class 1 completed all of the activities to a very high standard. Although Student 1-12 completed four of the five worksheets, his average results were well below the 75% minimum requirement. Both of the students with a high attitude grade for the year and a high asTTle result from Year 10 completed the worksheet with 100%. It can be seen that very few students completed the activities regardless of their attitude grade in other areas or their expected academic ability from their asTTle grade and is evidence of the level of disruption in the class.

Table 12 reveals that nine of the seventeen students in Class 2 completed all of the activities for this Unit Standard. The top six students all had a high or average attitude grade and all achieved more than the 75% minimum grade for both their activities and the worksheet. The quieter working environment enabled more of the students to concentrate on finishing their work.

Table 12: Results from theory when studied on paper by the students in Class 2 sorted by the number of completed activities, their average result and their attitude grade. Yr. 10 asTTle results and worksheet result are also included. The highest and lowest grades have been highlighted.

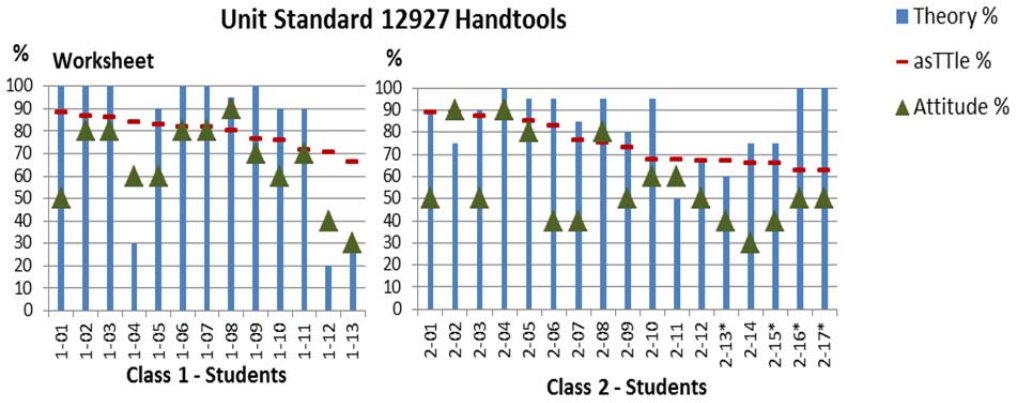
	Unit Standard 12927 Hand Tools Theory					
	asTTle High/ Average/ Low	Attitude High/ Average/ Low	Student	No. of Activities Completed From 5	Average Results in %	Worksheet Result in %
Class 2	H	H	2-02	5	95	100
	H	H	2-04	5	93	95
	A	H	2-05	5	91	95
	A	H	2-08	5	90	95
	L	A	2-11	5	86	95
	L	A	2-10	5	84	75
	H	L	2-03	5	72	50
	L	L	2-16	5	67	90
	A	L	2-06	5	66	100
	L	L	2-15	2	76	75
	L	L	2-14	2	66	75
	A	L	2-09	1	100	66
	L	L	2-12	1	75	80
	H	L	2-01	0	0	90
	L	L	2-17	0	0	100
	A	L	2-07	0	0	85
	L	L	2-13	0	0	60

Student 2-03 in Class 2 failed to achieve the required level of achievement despite having one of the highest asTTle grades in the two classes. The five students to fail this unit standard had a low overall attitude grade. The other student (Student 1-04, Class 1) had not attempted any of the activities but did re-attempt and pass the worksheet.

The students in both classes took the worksheet seriously. The students were told that the worksheet was compulsory and that a satisfactory result was required from each of them before any practical work would resume in the workshop. The students were still unaware that the activities were optional.

Figure 14 shows the results for the worksheet before the students had a chance to correct their mistakes. It can be seen that the students put considerably more effort into this activity, helped by the awareness that they could not just sit the lesson out and that the only way to return to the workshop and their practical work was to complete the worksheet to a satisfactory standard.

Figure 14: Worksheet results for Unit Standard 12927 Hand Tools.



Of the three students in Class 1 who achieved poor results in the worksheet (1-04, 1-12, and 1-13), only student 1-04 took the opportunity to correct his answers to improve his grades. The other two consequently failed the Unit standard. In addition, neither student 1-12 nor 1-13 had practical grades which would have enabled them to pass the Unit Standard (see Figure 15).

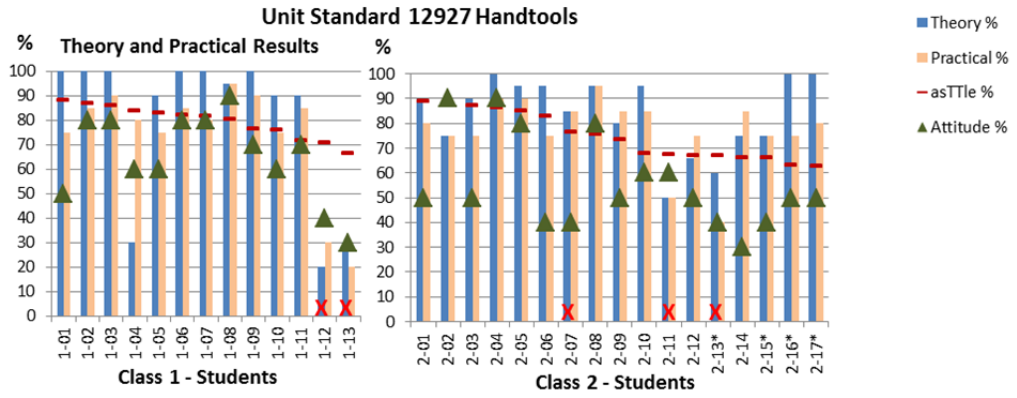
In Class 2, three students (2-07, 2-11, and 2-13) failed the Unit Standard. With good grades in his practical work, Student 2-07 should have been able to pass easily but did not put in the effort required to find the missing 5% in the theory, even to the point of refusing point blank to take a quick oral test to help him pass. Attendance records show that this student had been absent from class when the other students were working on the activity sheets and he had made no attempt to catch up with this work.

Student 2-13 was one of the "at-risk" students identified by the school as having genuine learning difficulties. Even so, with more effort and better attitude the theory in this Unit Standard should have been well within reach. His approach to his work often appeared to be the result of "conditioning" to expect poor results which, in turn, became an excuse to not even try.

Many students protested that the reason they had no interest in written theory was because they only really wanted to do practical work and that they would work hard if they were allowed to do this. However, with only one exception (Student 1-04, Class1) the practical results show that poor achievement in written activities was also an indication of the amount of effort that the students

would put into their work in general, including their practical work. Figure 15 shows the students' results of both the worksheet and their corresponding practical achievement.

Figure 15: Theory and results for Unit Standard 12927 Hand Tools with the corresponding overall practical results.



In Figure 15, the students who failed the Unit Standard have been marked with an "X". Attitude was a contributing factor to the non-achievement of all but one of the students (Student 2-11 (Class 2)). This student experienced genuine difficulties in his practical work which may have impacted on his attitude towards the written work which he should have been more that capable of passing.

Most of the students put in the required effort into their worksheet and practical work in this Unit Standard. The lack of engagement with the activities was obvious, especially in Class 1. The fact that it was difficult to maintain a quiet working environment in this class may have been a contributed towards the lack of achievement of some of the students through this distraction, while the culprits had made the conscious decision not to participate. The students in Class 2 were more willing to quietly work through the activities. Those in Class 2 who did not achieve a satisfactory result were also more willing to revisit the worksheet which, for four of them (Students 2-02, 2-09, 2-14, 2-15), led to the successful completion of the Unit standard.

4.2.3 Introducing a Blended Learning Environment into the Workshop

Introduction

In a traditional teaching environment for graphics, whether sketching or instrumental drawing is being taught, the teacher must spend a large amount of time facing away from the students. This loss of eye-contact contributes to many of the classroom management issues in even the quietest class. There are other issues which modern technology can also address. On a whiteboard, it is difficult to re-show a difficult technique or concept and students have difficulty relating their own work to the work on the

board. Using a high quality web-camera, a laptop and data projector, a blended learning environment was created where a recording of the demonstration was able to be replayed at any time for slower students and for students who were absent. It also allowed eye-contact to be maintained throughout and the demonstration could take place on equipment identical to the students' own equipment, effectively removing the abstract element of having to convert a whiteboard demonstration onto a drawing board.

Unit standard 7499 (Freehand Sketching) was taught from the whiteboard in the traditional manner, showing basic sketching techniques for use in the building trade. Unit Standard 7502 (Instrumental Drawing) was taught using the blended learning environment, with the students learning to draw basic plans to scale.

4.2.4 Unit Standard 7499 Use Freehand Sketching for Graphic Communication

About this Unit Standard

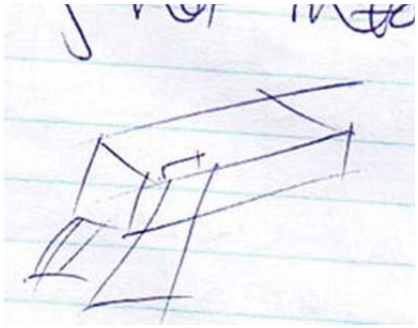
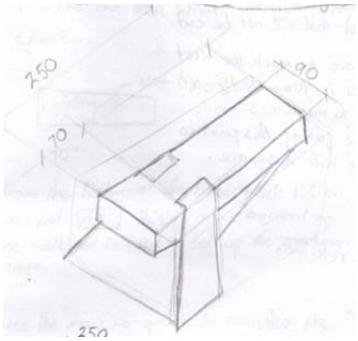
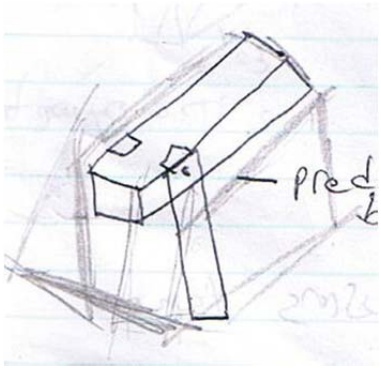
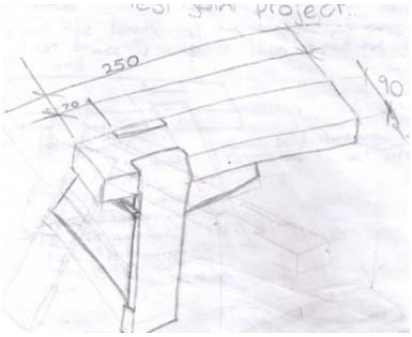
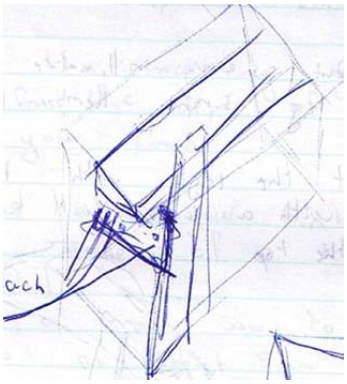
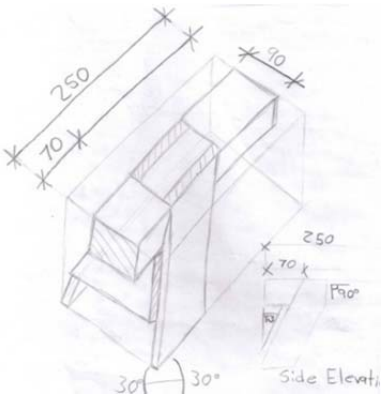
One of the elementary skills to allow quick and easy communication in the construction industry is drawing. It is may be a quick sketch or a detailed set of plans. One of the fastest ways to learn how to read these drawings is to learn how to draw them as it makes the student aware of the process that goes into the drawing and where to look to obtain the information they require for the job. Most of the students had not taken Graphics as a subject so both classes had to start from scratch. For Unit Standard 7499 I used the usual methods of delivery for this type of work; printed worksheets, instructions and demonstrations on the whiteboard. The students used these sketches to clarify the written instructions for their practical projects. The level of achievement required for a satisfactory grade was scaled up with each new project as the students gained experience and more was expected of them.

Observation

There are many difficulties with this style of delivery in a workshop. It is hard enough to keep the attention of Graphics students in a quiet Graphics classroom but nearly impossible in a Carpentry workshop where the hard walls and floors create echo and every noise seems louder. Many students started talking as soon as the teacher turned to the board to draw on the whiteboard and noise levels quickly escalated. As a result, much of the lesson was spent with classroom management and progress was often painfully slow. The overall quality of the sketching was equally disappointing. Many of the students were not able to transfer what they saw demonstrated on the board into a sketch on their worksheet. Another disadvantage with the whiteboard was evident when students fell behind it in their

work. It was difficult to return to an earlier stage to clarify a point and once the board was cleaned it took a lot of work to restore the drawing. With two parallel classes this also meant that everything had to be drawn twice. The amount of effort that the students put into their work varied greatly from a few sloppy lines to some very acceptable working sketches complete with dimensions.

Table 13: Examples of student sketching for the Unit Standard 7499 taught using traditional whiteboard methods.

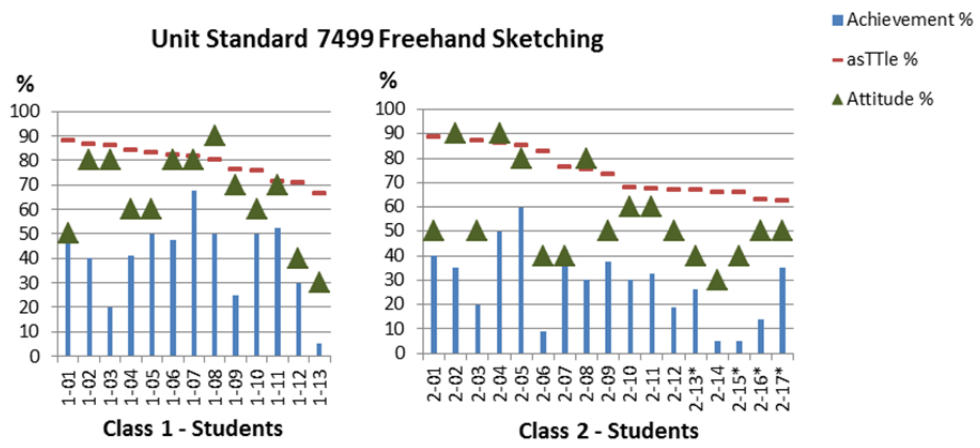
Unsatisfactory results	**Satisfactory results**
Example 1. Student 1-13, Class 1. 	**Example 4.** Student 2-05, Class 2. 
Example 2. Student 2-06, Class 2. 	**Example 5.** Student 1-11, Class 1. 
Example 3. Student 2-14, Class 2. 	**Example 6.** Student 1-07, Class 1. 

The examples shown in Table 13 are taken from a project towards the end of the assessment for this Unit Standard. The students all had the same amount of time to complete the sketches which were part of a series of drawings in the project instructions. Example 6 shows good use of the crating technique used to assist in constructing the drawing making proportion and the positioning of components easier. As this was one of the skills being assessed, it was compulsory for all of the 3D drawings to use this technique. Examples 4 and 5 also show an acceptable standard. While Example 3 also used this technique, very little effort was put into the drawing. In Example 2 the crating has been drawn over the top of the sketch as an afterthought and Example 1 has made no attempt to use any of the techniques required for this Unit Standard.

Results

Figure 16 shows the students' results for Unit Standard 7499 for Freehand Sketching. Less than 30% of the students passed this Unit Standard. The lowest grade was 5% and the highest result 68% leaving the average overall results at an unacceptable 34%. Students with the lowest overall attitude grade also scored the lowest results. The cases where students with a good overall attitude grade achieved poor results, it was usually an indication that they had genuinely struggled with the task and some did not enjoy sketching which impacted on their results.

Figure 16: Unit Standard 7499 Freehand Sketching Results.



These results indicate that this method of delivery is not ideal in a workshop situation due to the fact that the teacher's back is turned to the class for large periods of time, during which, contact with the class is lost.

4.2.5 Unit Standard 7502 Produce an Instrumental Orthographic Drawing

About this Unit Standard

The ability to read and understand plans and working drawings is a necessary skill for anyone working in Carpentry or any other trade. As with sketching, the fastest way to learn how to read plans is to learn how to draw them. In this unit standard, the students were required to draw an orthographic drawing for each of the three major projects for the year. The plans were drawn on A3 paper using drawing boards, T-squares and set squares. Instead of using a whiteboard to demonstrate the drawing techniques, a high quality webcam was used to record the demonstrations and while a data projector simultaneously displayed the demonstration on a large screen.

This particular blended learning environment was developed to target the following issues:

1. The teacher could demonstrate while facing the students thereby not losing contact with the class and making talking easier.
2. The demonstrations take place using the same equipment as the students, effectively removing the abstract element of the whiteboard and large, clumsy drawing instruments.
3. The viewpoint of the camera over the work was similar to the students' viewpoint of their own work.
4. Snapshots could be taken of critical stages of the drawing for later displayed for discussion and clarification.
5. The demonstration was recorded and could be played back in its entirety for students who were absent or those requiring extra tuition, freeing up the teacher to continue with the rest of the class.
6. The demonstration could be made available online for students to access in their own time from anywhere with Internet access.

Observation

Demonstrations for orthographic drawing typically have large amounts of time where the teacher is facing the board and has the back turned to the class. This tends to encourage disinterested students, especially when there is a large group, to lose focus and wander off task. The ability to face the class during the whole demonstration made an immediate difference in this respect. Eye contact with the class was not lost; noise levels were to a minimum and very little time was lost to classroom management issues.

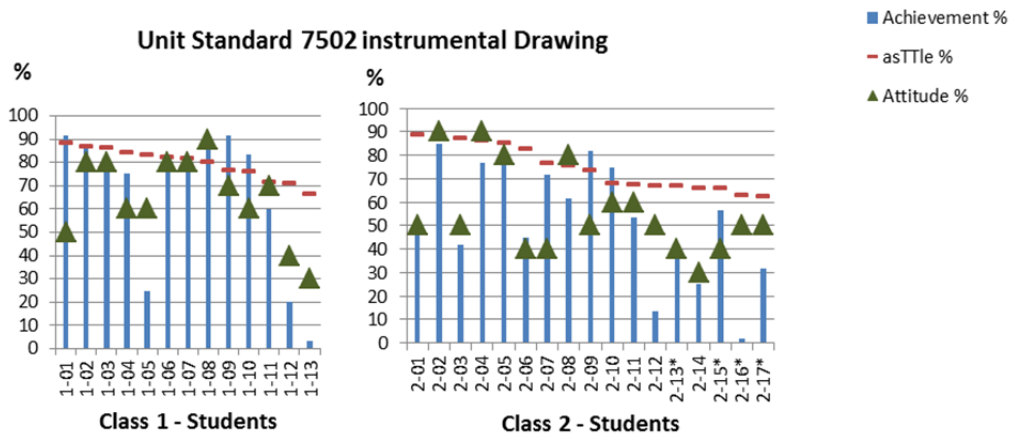
The snapshots and videos of the work allowed an immediate replay; assisting slower students with problems and reinforcing the learning of the other students. An unexpected positive side-effect from using the video replays was that the students remained focussed on the screen, avoiding classroom management issues while not drawing attention to the slower students.

The projected image showed the drawing from a viewpoint very similar to the student's own viewpoint with the added advantage that the teacher was not standing in front of the work during the demonstration. This meant that the students could follow every step of the process from any position in the room.

Results

Figure 17 shows that the overall standard lifted immensely. The highest overall result was 92 with many scoring 85 -90%. The Average result was now 59% compared to 34% for Unit Standard 7499. Another very pleasing result was that 57% of the class passed the Unit Standard.

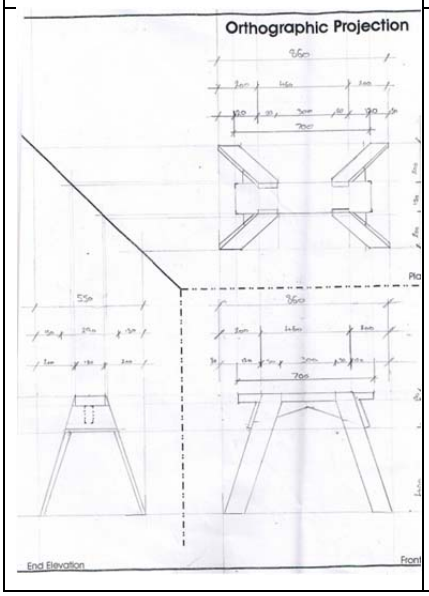
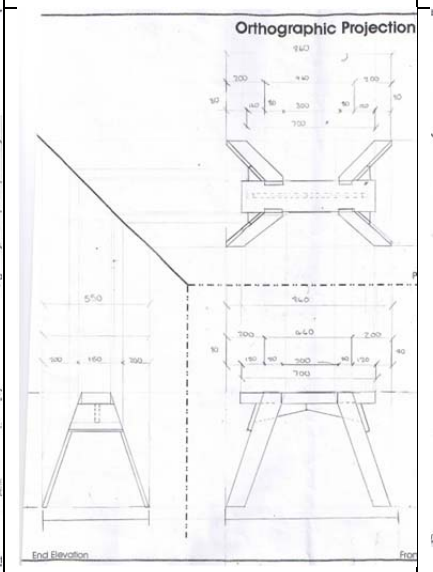
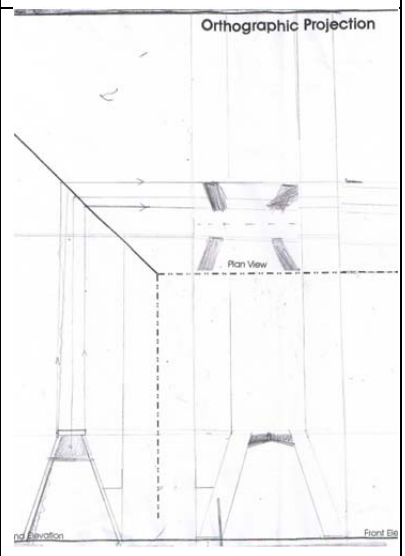
Figure 17: Unit Standard 7502 Instrument Drawing Results using a Blended learning Environment as the Delivery Method.



Most of the students achieved better results in the blended learning environment even though the orthographic drawings were more complex than the sketching. Four of the five students who achieved very poorly in the orthographic instrumental drawing also failed the sketching unit. It was obvious during marking that these students had made little or no effort to complete the work to a satisfactory standard. Student 2-16 was one of the students that had been identified by the school as having learning difficulties. Although he obviously struggled with this work, he could have easily achieved better results. Talking to him afterwards, it became clear that his lack of faith in his ability to achieve

good results had been an insurmountable problem for him and that he had already decided at the outset that he would fail.

Figure 18: Examples of student work for Unit Standard 7502. Even at this reduced scale the difference in quality between the pass results and the fail result is evident.

Student 1-09 (Pass)	Student 1-01 (Pass)	Student 2-16 (Fail)
		

Larger scale examples of the students' work may be found in Appendix D.

The students who seemed to benefit the most were those who had achieved in the mid to upper range in their Year 10 asTTle results. Generally, these students seemed to have a better work ethic and were more prepared to put effort into learning new skills than the students with lower asTTle results even if their overall attitude was poor.

Technology cannot replace good teaching methods but it did enhance the teaching and learning experience for both the teacher and the students in this instance. The students were more manageable and more focused when watching the large screen. The camera displayed what the students saw when looking at their own work making the task less abstract for them and the ability for instant replays made explaining difficult techniques easy. The overall results were only a 10% improvement on the previous year. What made the results so outstanding was that it had previously taken three weeks to complete the work as opposed to a week in the blended learning environment. As a result, two extra weeks were available for practical workshop activities.

4.2.6 Introducing Online Interactive Resources

Introduction

The previous section showed that although student results improved marginally in a blended learning environment, there was a marked improvement in the students' productivity when working in a blended learning environment as opposed to a more traditional classroom environment. This section examines the students' working in an online environment, their interaction with the online resources and their results.

The online resources required for the theory component of the following unit standards were made available through the school's online learning environment, Ultranet, making them easily available from any computer connected to the Internet. The students were introduced to the learning resources in the workshop before they went to the computer pod. The online environment that the students would later be using was displayed using a data projector, while the questions asked by the students allowed the clarification of many issues they would face before the computer sessions commenced.

The workbook for Unit Standard 24352 (Demonstrate knowledge of and apply safe working practices in the construction of a BCATS project), supplied by the BCITO, was made available to the students as a PDF file. The exercises and worksheets had been converted into interactive online activities using "Hot Potatoes", a suite of 6 freeware applications developed specifically to enable teachers with little or no web design or HTML experience to be able to create basic interactive activities including multiple-choice, short-answer, jumbled-sentence, crossword, matching/ordering and gap-fill exercises.

4.2.7 Unit Standard 24352 Demonstrate Knowledge of and Apply Safe Working Practices in the Construction of a BCATS Project.

About this Unit Standard

This unit standard had both a practical and a theory component. For the practical component, the students would be under observation for the rest of the course regarding their knowledge and implementation of safe working practices in the workshop. This was the most important Unit Standard of the course as students engaging in unsafe practices in the workshop where they put themselves or other students in danger or where materials and machinery were maliciously damaged would not only fail the Unit Standard but also fail the course as every Unit Standard within the course had a compulsory safety component. The theory component had four activities and a worksheet relating to safety in a Carpentry workshop. As in the previous Unit Standard, the students were

unaware that the activities were an optional component towards fulfilling the requirements of the Unit Standard.

Observation

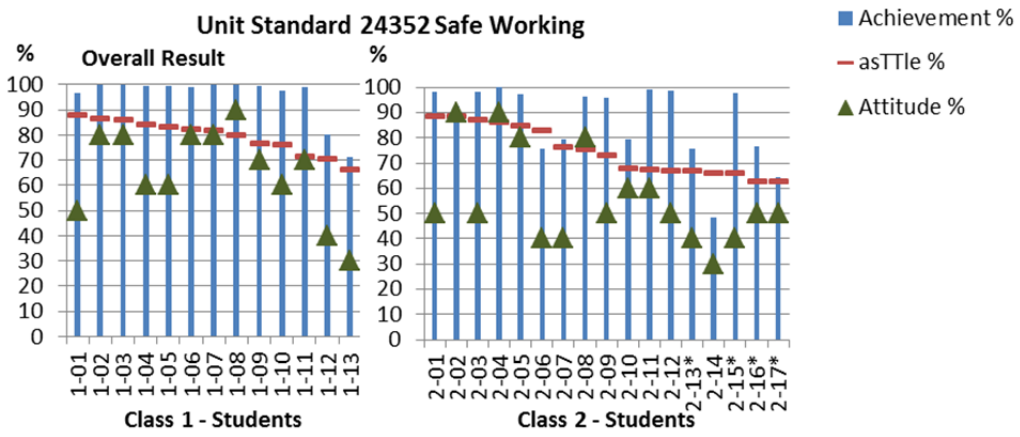
The computer pod had only 12 computers which meant that all of the students in the larger class and half of the students in the smaller class had to share a computer making the first session very important for setting the tone and work ethic when working in this environment. In the past, sharing computers had not been successful, leading mostly to unwanted distraction among the students. The exception to this had been during the pilot study in 2008, also using Hot Potatoes interactive resources. In the pilot study the students had worked extremely well and it was interesting to see if this success could be replicated.

In spite the fact that rugby held the topic of conversation in the room, the students focused on their work which would have been unheard of when working with paper resources. The students also worked far more collaboratively on computers than on paper with both students at each computer actively seeking the answers they required. As mentioned previously, the usual scenario when students worked with the paper resources often revealed that a lot of guesswork went into answering the questions for both the activities and the worksheets. The first student to write an answer was often copied with little or no questioning as to whether the answer was correct or not. The Hot Potatoes resources, on the other hand, gave the students instant feedback. They could immediately see whether an answer was correct giving them the opportunity to correct their answers or retake the test straight away. The Hot Potatoes resources also kept the students so occupied that surfing the Internet was not an issue. The activities had a built in timer which pressured the students to continue their work at a set pace. If resource timed out, the student would have to start over again. An element of competition was obvious amongst the students as they vied with one another to see who could achieve the highest score with the most time remaining on the clock.

Results

Looking at the results in Figure 19 it is apparent that the students with the lowest attitude results and the students with the lowest year 10 asTTle grades achieved the lowest overall grades. These students failed to complete the theory and, consequently, did not pass the Unit Standard. The overall results only show part of the picture however, for although there were four students who achieved grades lower than 90% when attempting the online activities, most of the students whose average was under 90% lost marks because they did not attempt one or more activities at all.

Figure 19: Unit Standard 24352 Demonstrate Knowledge of and Apply Safe Working Practices in the Construction of a BCATS Project – Combined Average Results of the Activities and Worksheets.



To get a clear picture of how the students interacted with the online learning resources it is necessary to look at each of the activities and worksheets individually. It can be seen that when the students attempted a worksheet they usually achieved results of 90%+. A trend was apparent where the students with the highest overall results tended to complete all of the activities and the worksheet before rewarding themselves with a break while those with poor overall results would only complete one or two exercises before rewarding themselves.

Figure 20: Unit Standard 24352 Demonstrate Knowledge of and Apply Safe Working Practices in the Construction of a BCATS Project – Activity and Worksheet results separated.

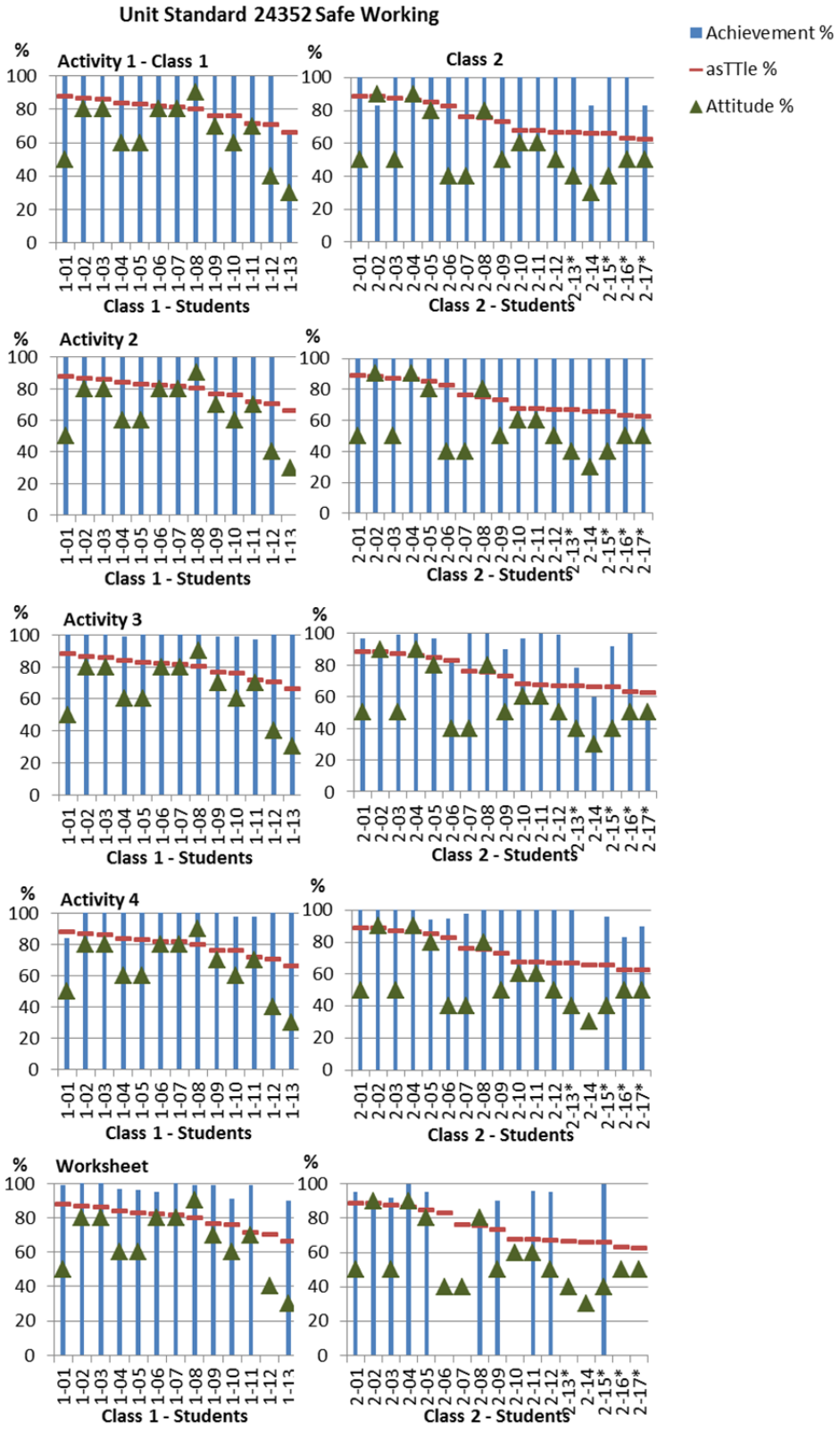


Figure 20 separates the results for each of the activities and the worksheet for the Unit standard. In Class 1, two of the students (1-12, 1-13) did not attempt one of the activities each. In Class 2 there were six students (2-06, 2-0 7, 2-10, 2-13, 2-16, and 2-17) who did not attempt one of the activities and one student (2-14) who did not attempt two activities.

Four students in this class (2-13, 2-15, 2-16, and 2-17) had been identified by the school as “at risk” regarding their academic ability. In spite of this, all of them achieved 100% in one or more activities with minimal teacher input and student 2-15 passed the theory for the unit standard with an average of 97.6%.

The activities that were attempted were completed to a very high standard with the median being between 96% and 100% as opposed to between 75% and 90% for Unit Standard 12927. The lowest score for an attempted activity was 50% as opposed to 7% for the same unit standard on paper resources. The results show that the same students consistently achieved poor results, usually by failing to complete all of the required tasks

Attitude plays a large role in student achievement and students with lower attitude grades were shown to be more likely to achieve poor results of fail to complete tasks. Although a high Year 10 asTTle result was no guarantee that a student would do well, it also seemed that the lower the asTTle result in Year 10, the more likely a student was to not only achieve poor results but was also to have a poor attitude towards their work.

Overall, the results were pleasing for this unit. On paper resources, although the students knew they required 90% to pass, many would have handed in activities and worksheets that would achieve 50% or less when marked. A lot of time would have been spent correcting mistakes, or resits which would result in more marking.

The Hot Potatoes exercises could not be saved so the students were required to either print to paper, or preferably, to PDF. As the student number was also printed on every page, without which, the work would not be accepted, the students were compelled to submit their own work. If a student refreshed the page or navigated away from it, the resource would reset itself which resulted in all entries being deleted. This caught some students by surprise as they lost work they had not yet printed. There were some grumbles at this but all of the students repeated their work. This was a marked difference to the paper resources where some students refuse point blank to repeat work they had lost.

4.2.8 Unit Standard 24355 Demonstrate knowledge of Construction and Manufacturing Materials used in BCATS Projects.

About this Unit Standard

In Term 2 a server crash disrupted online access to the interactive resources created for this course. As it was unknown how long it would be before the service was restored, it was decided that the students should complete this unit standard on paper resources and if time allowed, the interactive resources would be attempted to give a direct comparison between paper resources and interactive online resources using the same students on the same unit standards using two very different delivery methods.

This unit standard had no practical component making the theory doubly important. The students were required to differentiate between different materials and their uses as well as which tools to use and the safety measures required. The BCITO paper resources contained two large activity sheets and a worksheet. However, responding to feedback from the students regarding the size of the previous online resources and their limitations, the activity sheets were split for the online resources so that if a student had to restart an activity they would lose a smaller portion of their work. As each Hot Potatoes programme could only create one type of exercise, the split enabled a greater variety of tasks and also made it easier to match the questions to a suitable Hot Potatoes programme. This, in turn, gave the students more choice as to which activities to do first, helping maintain their interest.

Observation

Unlike the theory for Unit Standard 12927 for Hand Tools where the students had been left to use their own strategies to complete the work, the theory for this Unit standard was considerably more involved and complicated and so the students were tutored by the teacher in strategies to find the correct answers in the printed workbooks such as looking for key words in the question, using the index to navigate through the document and the glossary to clarify unknown words, acronyms and phrases. Even though the obvious weak points in the students' work habits using paper resources were directly targeted in this extra tuition, many students still reverted to guesswork with predictably poor results. Half of the students in Class 1 and over half of the students in Class 2 struggled with the written resources in this Unit Standard in spite of the extra tuition.

Failure to read a question fully was a common mistake resulting in the students either misinterpreting a question and giving a completely wrong answer or only reading the first part of a question and delivering a partial answer. The habit of glossing over the questioned was not easy to break. The

online interactive resources, however, forced students to read the questions and understand them as wrong or partial answers immediately gave a failed result.

Some of the students that did attempt to use the strategies they had been taught had difficulties which had not been covered in the extra tuition. These only became apparent once the students had started to analyse why they were having difficulties in spite of the strategies. In most cases the students were not able to express the problem themselves but in consultation with the teacher it was possible for the teacher to identify the problem.

It was surprising that many of the students could not apply the basics of alphabetic order, most notably Student 1-07 in Class 1. Many could only apply alphabetic order to the first letter but were not able to apply this to second or third letters. This seriously limited their ability to sort their own work and slowed them down when reading glossaries and indices as they could only narrow their search down to the first letter. This also left the students unable to use a dictionary with ease as the number of entries made a search prohibitively drawn out for them.

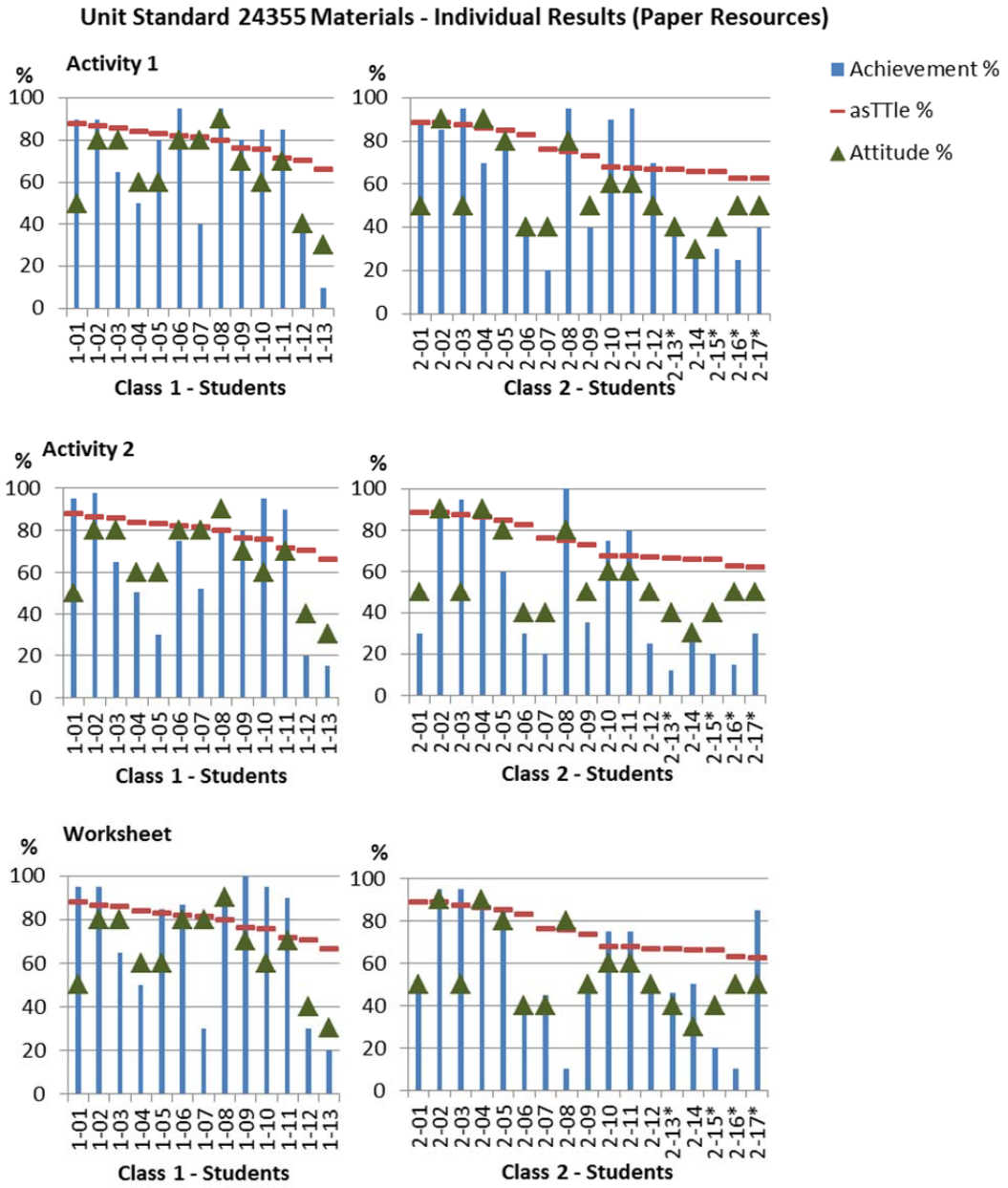
A very interesting reading anomaly was observed by some students. These students appeared to have a tendency to scan one particular area of a page from left to right before turning to the next page thereby missing large quantities of information. This habit could possibly stem from reading computer screens where the student reads and scrolls the page simultaneously, requiring less eye movement and allowing the reader to keep track of where they are more easily on a moving page. Once the end of the page is reached, the reader then clicks forward. Unfortunately for the students, the pages in the paper resources did not scroll, any information outside of the scanned area was left unread, increasing the difficulty of the activity for the student. This tendency to read one area of a page was revealed through questioning several students in both classes about their knowledge of the content of particular pages. In most cases the information that the student had read and could remember was located in the same area on the page for every page.

Only Student 2-16 in Class 2 admitted to reading for pleasure so for most of the students, their reading was limited to the minimum required to progress through their school work. This also meant that many students found the physical size and thickness of the paper resources daunting. The students showed a tendency measure the amount of reading by the weight of the booklet. Past experience had shown that students were more likely to complain about reading a booklet that was printed single sided than when they were faced with the same booklet printed double sided which was half the thickness even when they were aware that the material was identical.

Results using paper resources

As in the previous results, the students with an overall attitude grade of 50% or lower were more likely to achieve poor results (Figure 21 on the next page). Student 1-07 in Class 1 could have achieved far better results had he tried. His poor results reflected a lack of care in reading the questions and checking his answers. In most cases he had only delivered partial answers to the questions. The results from Students 2-12 and 2-13 in Class 2 also showed the effort they put into their work and was a reflection of their attitude in general. The Students 2-13, 2-15, 2-16, and 2-17 struggled. Student 2-17 put in a huge amount of effort into his work and made a determined effort to apply the strategies he had learned which resulted in his achieving 85% in the worksheet. Student 2-08 gave up after completing the activities to a high standard and failed to achieve 10% in the worksheet. Using the interactive online resources, this student completed all of the work with an average of 99.6%.

Figure 21: Student Results using BCITO Paper Resources for Unit standard 24355 Demonstrate knowledge of Construction and Manufacturing Materials used in BCATS Projects.



It had been an unexpected revelation that so many students had difficulty with the concept of alphabetic order. It helped to explain why even some relatively simple tasks became an insurmountable problem for them when working with paper resources as they had very few options to take short-cuts and find information without reducing the quality of their work. On a computer these students see their search steadily refining as they type more letters of the word or term that they were searching for without realising that the found list is sorted alphabetically with a hierarchy that goes beyond the first letter because the computer is doing it for them. The same applied when the students sorted lists. The computer did for them what they could not do on paper themselves.

Once again, attitude played a big role in determining student success. Although this was true with all of the activities in the course, it was most noticeable when the students are required to do theory.

4.2.9 Online resources for this Unit Standard after the server was replaced.

Introduction

Although the school network was up and running earlier than expected, it took until the first weeks of Term 3 to restore all of the settings that would allow the online interactive resources to be accessed, circumventing some of the limitations that Ultranet placed upon the users such as where online content was stored.

The students responded enthusiastically to the prospect of working on the computers once again. None of the students realised that the theory had identical questions to the paper resources or that they were repeating the work.

Several students commented that the paper resources all looked the same to them. While most of the content was different, topics such as safety and the machinery for particular materials were often repeated, making it difficult for the students to tell one Unit Standard apart from the other as they thumbed through the booklets to spot familiar content rather than read the Unit Standard number on the front cover. With the online resources, the students had to search for the Unit Standards by number which seemed to help them remember which ones they had completed and which they had not.

Observation

Class 1 settled quickly into their first session back on the computers once student 1-13 and one other student had been removed from the class for disobedience. The students used a wide variety of strategies to complete their work. These included writing notes in Microsoft Word, searching the text

for key words, cutting and pasting difficult words and phrases and peer to peer interaction. All of this generated a lot of interaction with the questions and the answers with the students generally striving for a 100% result in the shortest possible time.

Class 2 had more pressure on the computers as they all had to work in pairs on a computer. This class used fewer strategies for obtaining the correct answers in their activities and worksheets. Although students interacted well with each other and there was a lot of collaboration between the pairs working on the computers, the prime strategy was to read the text then cut and paste the answer, word or phrase they had found into their work. This made progress a lot slower which may have accounted for many of the students not completing the worksheet. This should not have been an excuse as the online resources were available to them from any computer connected to the Internet. Only Students 2-05 and 2-10 in Class 2 made use of the online availability for this Unit Standard, both achieving excellent grades. Student 2-10 struggled to meet deadlines in class but his determination to finish his work and the willingness to put in his own time with the online resources helped him achieve his goals. Student 2-05 was a perfectionist which cost him time in class and although he was perfectly capable of finishing his work on time, tried to improve his grades by resitting the tests at home.

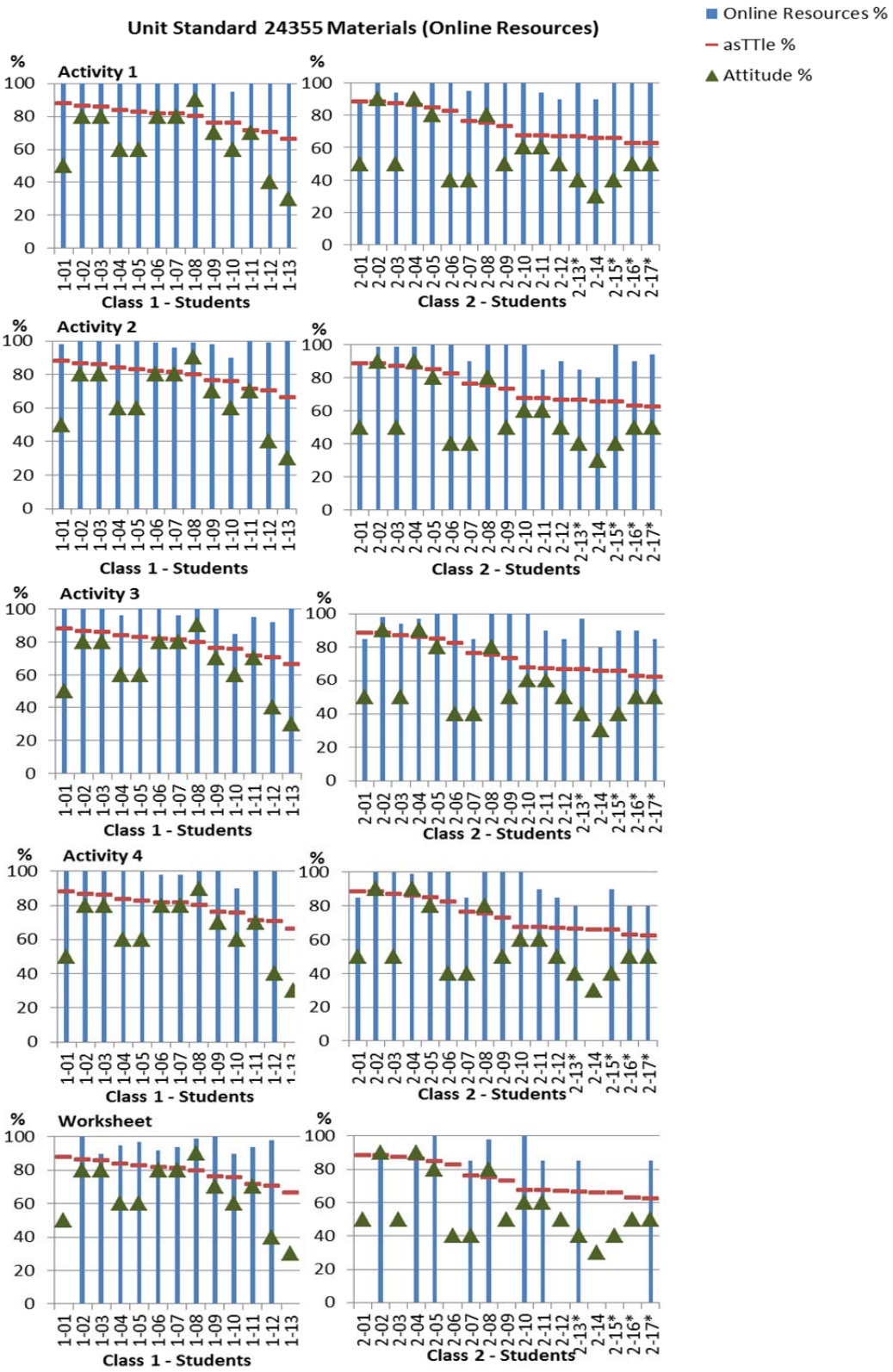
It was apparent that poor work habits and poor attitude were major contributors for work not being completed, especially where the students had an overall attitude of 50% or less. Included in this group were Students 1-15 and 1-16 from the "at risk" group. However, Students 1-13 and 1-17 from this group completed their work with results of over 80% which shows that both the level and the amount of work were well within the groups' capabilities.

Results using online resources

In Class 1, Student 1-13 failed to complete one activity and the worksheet while Student 1-01 failed to complete the worksheet although the work was well within his capabilities. The remaining students all completed the activities and worksheets with grades of between 90% -100% (Figure 22).

It can also be seen from the results that the students were still fresh and enthusiastic to be back on the computers in Activities 1and 2 (The equivalent of Activity 1 on the paper resources). All of the students were engaged and the average grade over the two classes was 97% as opposed to 65% on paper. Activities 3 and 4 (Activity 2 on the paper resources) returned an average grade of 95% as opposed to 56% on the paper resources. Finally, for those students who attempted the worksheet, the average grade was 94% as opposed to 63% on paper.

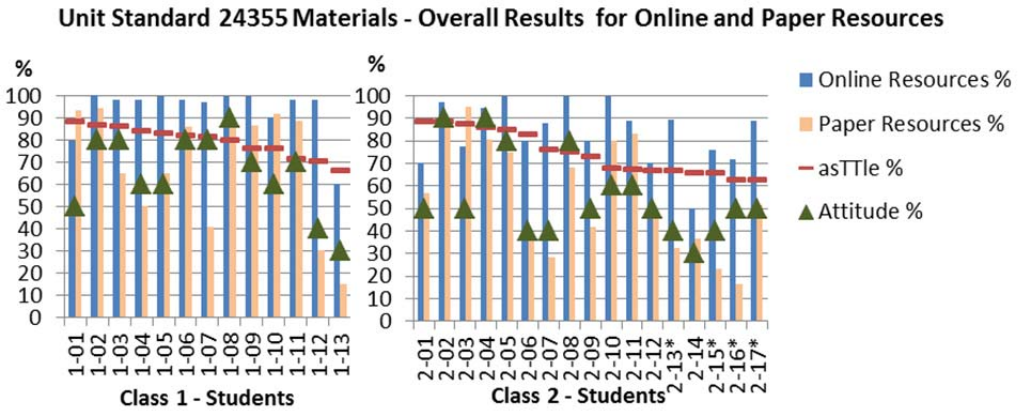
Figure 22: Online Resource Results from Unit standard 24355 Demonstrate knowledge of Construction and Manufacturing Materials used in BCATS Projects.



Results using Online Resources Compared to Paper Resources

When working on the paper resources, the patterns of student achievement were similar to those of the students' Record of Work. Only Student 1-01 in Class 1 achieved better overall results on paper than with the online resources. This student had good overall ability but was let down by his attitude towards his work in many areas. The low result with the online resources indicated a lack of engagement rather than a lack of ability. The majority of the students improved their grades markedly when working online (Figure 23).

Figure 23: Unit Standard 24355 Materials – Online Results compared to Paper.

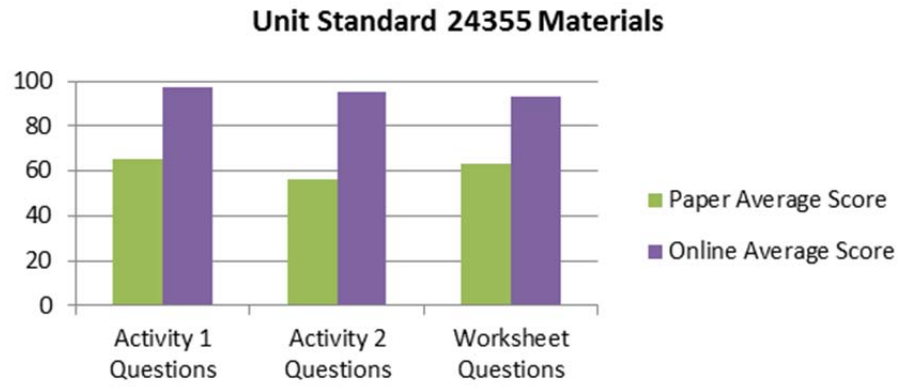


It can also be seen that the students who achieved well on both paper and online had either achieved higher asTTle results in Year 10 or had an overall attitude grade of 60% or above. For the remaining students, their increased overall grade when using the online resources indicated a change in attitude towards the material itself when delivered in an online environment. As in Unit Standard 24352, the average results of individual students were not the result of low grades when attempting an activity online but that they did not attempt some of the activities at all.

On paper, the students would write anything down, just to fill in the gaps to make it look as if they knew the answers and to avoid trouble for not working. The results were understandably poor for all of the work they attempted. In comparison, when the students worked online the sheets were self-marking giving the students instant feedback. It was not immediately visible how many activities or worksheets the students had completed but they worked hard to obtain the highest possible score on the visible worksheet to impress their neighbours.

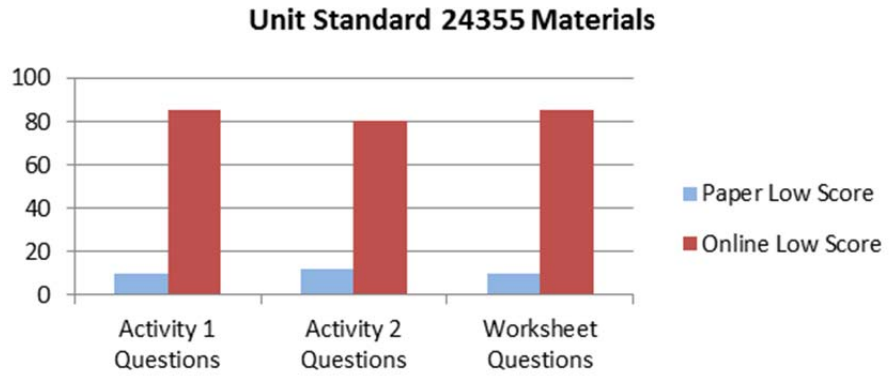
When comparing the average results of the online resources and paper resources (Figure 24), the difference is not particularly spectacular but certainly enough to justify the time required to convert any paper-based resources into online resources.

Figure 24: A comparison of average student results on paper and online resources for Unit Standard 24355.



It is not until the lowest results are compared (Figure 25) that the real difference between the two modes of delivery is revealed. On paper, many of the students handed in activity sheets and worksheets where they achieved less than 50% and some as low as 10%. This could have lead to the conclusion that the material was too difficult for the students involved. However, the lowest result with identical material in an online setting was 85% for the activities or worksheets that were attempted. This would seem to indicate that it is not the material itself, rather the method of delivery and the attitude of the students themselves towards their working environment that makes the difference.

Figure 25: A comparison of the lowest student results on paper and online resources for Unit Standard 24355.



From the results, it is evident that the students are capable of the level of work required for the Unit Standard. It is also clear that the students prefer to work in an online environment and achieve better results for the work they attempt. This raises the question as to how students could be encouraged to work to this standard in all their theory.

4.2.10 Unit Standard 24356 Apply Elementary Workshop Procedures and Processes for BCATS Projects

About this Unit Standard

This was the final Unit Standard to be assessed in the research cycle. Once again, the material had been adapted from the paper BCITO resources using Hot Potatoes. After consultation with the students and appraisal of the way the students interacted with the online resources, the activities and worksheets had been broken down into smaller one to three question exercises depending on the content and difficulty of the material and the Hot Potatoes programme used in the creation.

The Unit standard itself covered areas that the students had been practicing all year such as preparing and understanding job specifications, selecting the correct tools and materials as well as safety in the workshop, with machinery and using hazardous substances.

The observation and results in this section pertain only to theory where the students used the online resources.

Observation

This Unit standard was made available to the students while they were still working on the previous Unit Standard. Having more than one Unit Standard available to the students at any one time had ultimately been planned with the intention of keeping faster students occupied and on task as well as allowing students who were struggling to look ahead at the next Unit Standard and perhaps even complete some of the easier exercises. This strategy worked to a certain extent with the faster students who then gained a substantial lead in the work they had completed. This was especially true in Class 1 where lower class numbers meant the students had more access to a computer for the whole period.

A major observable difference was that the students who completed their work tended to work steadily, only stopping to look at the results and congratulate themselves at the end of the period while those who did not complete their work tended to stop and relax after completing one or two exercises.

This tendency to stop and reward themselves after only one or two exercises was understandable in some respects. Talking to the students and looking at their results on paper resources highlighted that

these students very seldom achieved high grades. The high grades from the online resources seemed to mislead the students into believing that they had achieved more than was actually the case; even though the course requirements and the need for completion were regularly refreshed in their minds.

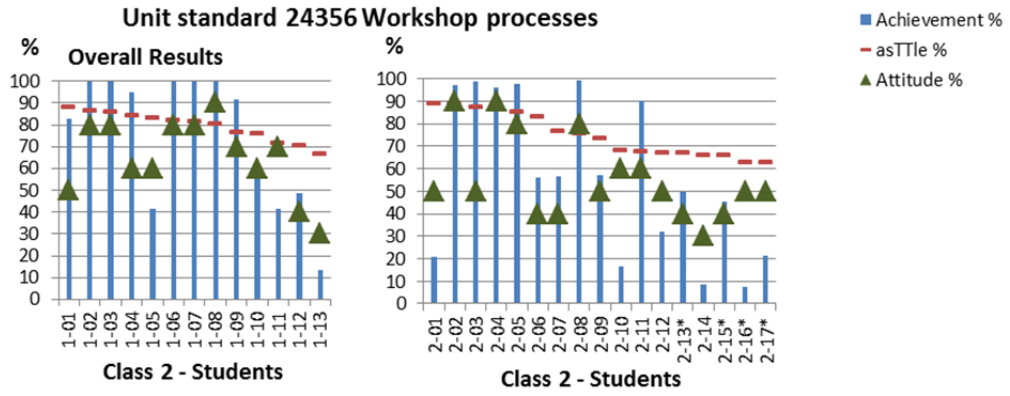
Results

Just over half of the students in Class 1 completed everything, including the worksheets. Student 1-01 in this class was again let down by his attitude to the work as were Students 1-12 and 1-13. Students 1-09, 1-10 and 1-11 struggled with the quantity of work, falling behind some of the faster students but still managed to complete Unit Standard 24355 by the end of the year.

In Class 2, the link between student attitude and completion of the set work can be clearly seen. Students with an overall attitude grade of 60% were more likely to leave work incomplete. The students with low asTTle results from Year 10 made up the majority of these students. Amongst these were Students 2-13, 2-15, 2-16 and 2-17, identified by the school as "at risk". These students had been steadily slipping behind in their work as the year progressed. Students 2-13, 2-16 and 2-17 did attempt some of the activities and worksheets, achieving good results in these individual exercises but not enough to pass the unit standard.

On paper, the students would have attempted most of the questions and performed badly, indicating that the level of work was too difficult for them. The online resources showed that the level of work is well within the students' capabilities or they would not achieve such high grades in the individual exercises. Rather, it is the quantity of work and the students' strategies for dealing with this work that are problematic for them. Figure 26 shows the overall results for this Unit Standard when the students are sorted by their Yr. 10 asTTle grade.

Figure 26: Average Overall Student Results for Unit Standard 24356 when working with interactive online resources - Sorted by Yr. 10 asTTle Results.



Again, the overall result only shows part of the picture. When the average results of the attempted activities and worksheets is displayed (Table 14 and Table 15) it can be seen that even the students who failed to complete the Unit Standard achieved average results of between 95-100% in Class 1 and 86-99% in the academically weaker Class 2.

Table 14: Results from Unit Standard 24356 as online resources by the students in Class 1 - Sorted by the number of completed activities, their average result and their attitude grade. Yr. 10 asTTle results and worksheet result are also included. The students who completed all of the activities/worksheets are highlighted at the top of the table. Those who failed to complete all of the activities/worksheets and therefore failed the unit standard are highlighted at the bottom of the table.

	Unit Standard 24356 Workshop Procedures Theory					
	asTTle High/ Average/ Low	**Attitude** High/ Average/ Low	**Student**	**No. of Activities/ Worksheets Completed From 12**	**Average Results in %**	**Overall Result in %**
Class 1	**H**	**H**	**1-03**	**12**	**100**	**100**
	A	**H**	**1-07**	**12**	**100**	**100**
	A	**H**	**1-06**	**12**	**100**	**100**
	A	**H**	**1-08**	**12**	**100**	**100**
	H	**H**	**1-02**	**12**	**100**	**100**
	A	**A**	**1-04**	**12**	**95**	**95**
	A	**A**	**1-05**	**12**	**100**	**100**
	A	A	1-09	11	100	92
	H	L	1-01	10	100	83
	A	**A**	**1-10**	**7**	**99**	**58**
	L	**L**	**1-12**	**6**	**98**	**49**
	L	**L**	**1-13**	**6**	**100**	**13**
	L	**A**	**1-11**	**5**	**100**	**42**

From the Class 2 results it can be seen that the students with a low overall attitude grade were most likely not to complete their work. Added to this was the pressure of having to share the computers which also contributed to the slower work rate.

Table 15: Results from Unit Standard 24356 as online resources by the students in Class 2 - Sorted by the number of completed activities, their average result and their attitude grade. Yr. 10 asTTle results and worksheet result are also included. The students who completed all of the activities/worksheets are highlighted at the top of the table. Those who failed to complete all of the activities/worksheets and therefore failed the unit standard are highlighted at the bottom of the table.

	Unit Standard 24356 Workshop Procedures Theory					
	asTTle High/ Average/ Low	Attitude High/ Average/ Low	Student	No. of Activities Completed From 5	Average Results in %	Worksheet Result in %
Class 2	A	H	2-08	12	99	99
	H	L	2-03	12	99	99
	A	H	2-05	12	98	98
	H	H	2-02	12	97	97
	H	H	2-04	12	96	96
	L	A	2-11	11	99	90
	A	L	2-09	7	98	57
	A	L	2-07	7	97	57
	A	L	2-06	7	96	56
	L	L	2-13	6	99	50
	L	L	2-14	6	91	46
	H	L	2-01	6	99	21
	L	L	2-12	4	96	32
	L	L	2-17	3	86	21
	L	A	2-10	2	100	17
	L	L	2-15	1	100	8
	L	L	2-16	1	88	7

Most students attempted the first activities but as many of the slower students were still occupied with the previous unit standard, the gaps in the work became more obvious as the term came to an end.

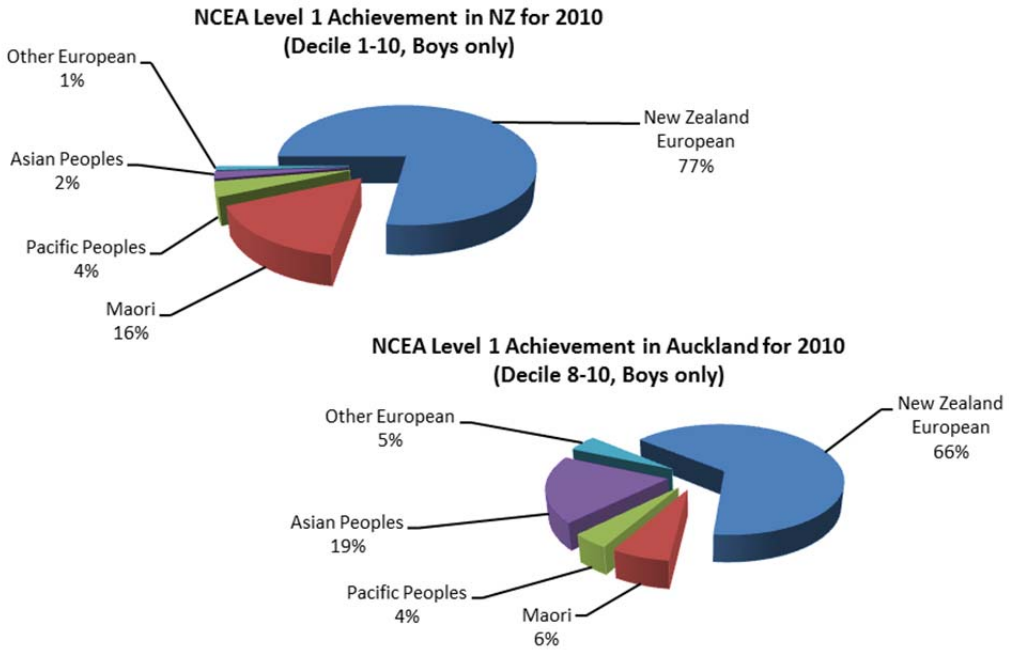
For the work that was completed, the average results were between 86% and 100%.

Overview

Overall achievement

The findings section began with a comparison of the sample group against national and regional statistics to ascertain how representative this group of students was against the wider population. It was shown that this group of students was similar to the wider population in overall academic ability and ethnic distribution although proportionately double the number of Maori students opted to take Carpentry as a subject when the sample was compared with the general school population. Figure 27 shows firstly, a breakdown of the students in decile 1 – 10 schools who passed NCEA level 1 in New Zealand in 2010 and secondly, students in who passed NCEA level 1 in the Auckland region. Thus has been narrowed to decile 8 – 10 schools so that a comparison can be drawn between the school in the study and schools with similar socio-economic circumstances.

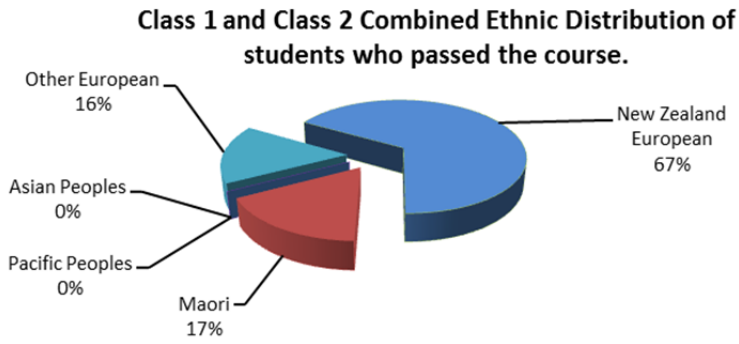
Figure 27: Ethnic Breakdown of Student Achievement for NCEA Level 1 in NZ and in the Auckland Region in 2010.



Source: http://www.nzqa.govt.nz/qualifications/ssq/statistics/provider-selected-crystalreport.do

It can be seen in Figure 28 on the next page, that the percentage of Maori to pass the Carpentry course was roughly the same as the national average in 2010 for Maori taking NCEA level 1 and proportionately similar to the number of Maori taking Carpentry as a subject.

Figure 28: Ethnic distribution of students in this study who passed Carpentry in 2010.



As the sample was comparatively small, one or two students made a large difference, for example, the ethnic group "Other European" consisted of 2 students in total, both of whom passed the course, resulting in a 100% pass rate for this group. Pacific Island and Asian ethnic groups were not represented as the students in the sample group chose not to participate in the study. The NZ European achievement rate was less than half what should have been expected but with a small sample group, the achievement of one or two students has a large influence on the overall result.

Table 16: A Comparison of the National NCEA Student Pass Rates in New Zealand and the Pass Rates of the Sample Group in Carpentry

National pass rates for Level 1 NCEA in 2010		
Ethnicity (No. of passes/No. of students)	**National %**	**Sample Group %**
NZ Maori (2/5)	58.2	40.0
NZ European (8/23)	79.2	34.7
Pasifika Peoples (0/0)	50.2	N/A
Asian (0/0)	73.1	N/A
Other European (2/2)	71.7	100.0
Overall in New Zealand	**75.1**	**40.0**

Source of national Statistics: http://www.nzqa.govt.nz/qualifications/ssq/statistics/provider-selected-crystalreport.do

Table 16 also shows the overall pass rate to be 40.0%, just over half the national average. Even when the students who missed the cut by one Unit Standard are added to the results of the students who

passed the course, the figure rises to just 53.3%. To find out which group of students was influencing the pass rate the most, the classes had to be separated (Table 17).

Table 17: A Comparison of the National NCEA Student Pass Rates in New Zealand and the Pass Rates of the Sample Group in Carpentry (separated into classes)

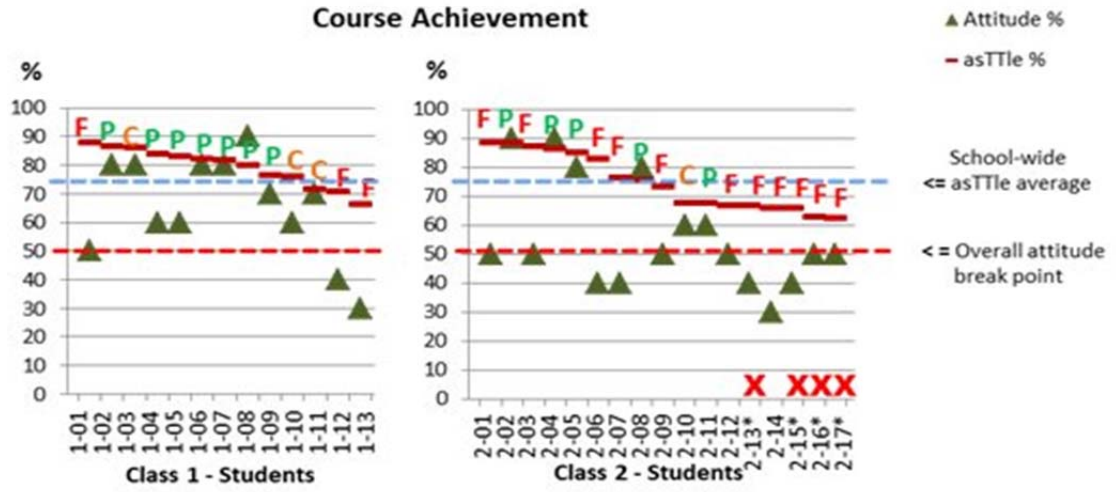
National pass rates for Level 1 NCEA in 2010 (separated into Classes)		
Ethnicity (No. of passes/No. of students)	**National %**	**Sample Group %**
Class 1		
NZ Maori (1/2)	58.2	50.0
NZ European (5/10)	79.2	50.0
Pasifika Peoples (0/0)	50.2	N/A
Asian (0/0)	73.1	N/A
Other European (1/1)	71.7	100.0
Class 2		
NZ Maori (1/3)	58.2	33.3
NZ European (3/13)	79.2	23.1
Pasifika Peoples (0/0)	50.2	N/A
Asian (0/0)	73.1	N/A
Other European (1/1)	71.7	100
Overall in New Zealand	**75.1**	**40.0**

Once separated, the difference between the two classes becomes clearer. When the 3 students who missed the cut by one Unit Standard from Class 1 are added to the group of students who passed the course, the pass rate for NZ Europeans rises to 80%, very close to the national average.

With only one student in this category in Class 2 the results change very little (from 23.1% to 30.7%, still well below the national average). Even when the results of the four students identified with learning difficulties are removed from the equation, the result still only rises 44.4% or just over half of the national average.

To understand this difference between the two classes, it is necessary to revisit some of the data used to track the performance of the students. The students were sorted by class and their Year 10 asTTle results allowing the progress of individual students to be tracked through different sets of results as each student remained in the same position on the charts regardless of achievement for each unit standard. The overall attitude grade for each student was also tracked to identify whether or not there was a correlation between attitude and student achievement. Figure 29 shows a clear link between student attitude and course completion. All the students whose overall attitude grade was at or below the break-point failed to complete the course, including the three students with top asTTle grades.

Figure 29: Carpentry Student Course Achievement - tracking student asTTle results and attitude grades in relation to course completion.



The students who passed the course are marked with a green “P”, the students who missed completion by just one Unit Standard have been marked with a “C” and those who missed completion by two or more Unit Standards have been marked with a red “F”. The students identified by the school as having learning difficulties have been identified at the bottom of the chart with an “X”.

asTTle grades and student achievement

The average school-wide asTTle results are shown as a blue dotted line at the 75% mark. Although this figure is a composite of the Maths and English grades, it does offer a means of comparison between students in relation to the general school population. As Figure 29 reveals, the only student to pass in the group below this line was Student 2-11 although Student 2-10 came close, and missed completing the course by just one Unit Standard.

It can also be seen that only Students 1-12 and 1-13 were just below this point which made up only 15% of the class. While they had not been identified by the school as having any particular learning difficulties, observation indicated that their lack of achievement was attributable to their poor attitude and work ethic in general.

In contrast, the students below the asTTle average made up 50% of the Sample group in Class 2 with half of those students (marked with a red "X") having been identified by the school as having a learning impairment or disability. Only one student with below average asTTle results completed the course as opposed to 50% of the students whose asTTle results were above the average point. It does seem that the low asTTle results of such a large portion of the class may have had an influencing factor on the overall achievement of the class, influencing the learning climate and the students' overall expectations of their own achievement.

Attitude grades and student achievement

The break point for the overall Attitude grade was 50% (shown as a red dotted line in Figure 29). No student with an overall attitude grade below this grade completed the course regardless of their Year 10 asTTle grade. In Class 1, only three students (23%) came into this category. If the three students who came very close to completing the course (marked with "C") are included in the overall results, student achievement in this class was very close to the national average.

In comparison, eleven of the seventeen students in Class 2 (64.7%), had an overall attitude of 50% or less which had a greater negative impact on the overall outcomes of the class than the low asTTle grades. The fact that Students 2-10 and 2-11 managed to achieve the grades they did showed that the work was well within the students' capabilities but the combination of poor attitude and poor achievement became an insurmountable problem for many of these students.

Work Patterns and student achievement

Over the course of the year, distinct work patterns began to emerge in different learning environments. Overall, student results in Class 1 were higher, with more consistent work patterns. In Class 2 the results tended to be more varied although some indication of work pattern trends is visible.

Some students had genuine difficulties with some activities but often, poor achievement coincided with a poor overall attitude grade. Students 1-01 and 2-01had consistently poor grades although neither of these students should have had trouble completing the work to a satisfactory level. The four students identified by the school as having learning disabilities have been marked with an asterisk (*) next to their code.

Student Achievement using Paper Resources

In the previous sections the students' work was looked at in isolation, unit standard by unit standard. Student interaction with the online resources becomes clearer when different learning environments and the resulting differences in work patterns are compared.

On paper resources, Students 1-02 and 1-03 (Class 1) and Students 2-02 and 2-08 (Class 2) genuinely struggled with written work (see Table 18). Difficulties in written expression often left these students frustrated. These students often chose to write nothing rather than embarrass themselves in front of the other students with their lack of writing skills. The grades of the remaining students tended to reflect the amount effort these students put into their work.

Despite high completion rates, student results using paper resources were mixed. Normally enthusiastic students struggled to achieve good results using these resources. The students with low attitude grades achieved the lowest overall average results on paper, except those with a high Yr. 10 asTTle grade. This was not unexpected as these students had already demonstrated in Year 10 that they had the basic written skills necessary to succeed, they just lacked motivation.

Table 18: Average results on paper resources for Class 1 showing the amount of work completed from each student and the respective overall attitude grade and yr. 10 asTTle results.(Students who failed to achieve the minimum 50% in this Unit Standard have been highlighted in grey)

	Overall Completion and Average Results on Paper resources				
	asTTle High/ Average/ Low	**Attitude** High/ Average/ Low	**Student Code**	**Work Completed in %**	**Average Results in %**
Class 1	A	H	1-08	100	79
	A	A	1-09	89	78
	L	A	1-11	100	78
	A	H	1-06	89	76
	H	H	1-02	100	73
	H	L	1-01	100	69
	A	A	1-10	89	68
	A	A	1-05	100	63
	A	H	1-07	100	59
	A	A	1-04	100	50
	H	H	1-03	100	49
	L	L	1-12	100	30
	L	L	1-13	100	10

Table 19: Average results on paper resources for Class 2 showing the amount of work completed from each student and the respective overall attitude grade and yr. 10 asTTle results. (Students who failed to achieve the minimum 50% in this Unit Standard have been highlighted in grey. Students identified by the school as having learning difficulties have an asterisk after their number)

	Overall Completion and Average Results on Paper resources				
	asTTle High/ Average/ Low	**Attitude** High/ Average/ Low	**Student Code**	**Work Completed in %**	**Average Results in %**
Class 2	L	A	2-10	78	72
	H	H	2-04	100	68
	H	L	2-03	78	65
	H	H	2-02	100	62
	A	H	2-05	100	62
	L	A	2-11	100	60
	H	L	2-01	100	51
	A	H	2-08	100	46
	A	L	2-09	100	43
	L	L	2-13*	100	43
	A	L	2-07	100	42
	L	L	2-17*	100	40
	A	L	2-06	89	32
	L	L	2-15*	89	32
	L	L	2-12	100	31
	L	L	2-14	78	23
	L	L	2-16*	89	17

Some students protested that they had not chosen a practical subject to do paper work and would work well once they started their workshop projects. While sounding plausible, and often repeated by the students throughout the year, Table 20 and

Table 21 show that although three or four students did improve their performance in a practical environment, the productivity of other students declined in this environment. Short bursts of effort from the students when being directly observed are evened out by taking the average student results throughout the year. It can be seen that students with a low attitude grade (generally those who protested the most loudly) did not work better in a practical environment. Although the average grades were generally slightly better for the practical work, completion rates for the practical projects was often well below that of the theory work.

Table 20: Written theory and practical project results for Class 1 – Sorted by the practical average results. (Students who failed to achieve the minimum 75% in this Unit Standard have been highlighted in grey)

	Written theory and practical project results						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Compl. Theory in %**	**Average Theory Results in %**	**Compl. Practical Work in %**	**Average Practical results in %**
Class 1	H	H	1-03	100	49	80	86
	H	H	1-02	100	73	80	84
	A	H	1-08	100	79	100	82
	A	A	1-09	89	78	100	82
	A	H	1-06	89	76	80	78
	L	A	1-11	100	78	80	78
	A	H	1-07	100	59	80	74
	A	A	1-10	89	68	60	72
	A	A	1-05	100	63	60	67
	A	A	1-04	100	50	60	67
	H	L	1-01	100	69	60	58
	L	L	1-12	100	30	60	47
	L	L	1-13	100	10	60	43

Table 21: Written theory and practical project results for Class 1 – Sorted by the practical average results. (Students who failed to achieve the minimum 75% in this Unit Standard have been highlighted in grey. Students identified by the school as having learning difficulties have an asterisk after their number)

	Written theory and practical project results						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Compl. Theory in %**	**Average Theory Results in %**	**Compl. Practical Work in %**	**Average Practical results in %**
Class 2	A	H	2-05	100	62	80	89
	A	L	2-07	100	42	80	89
	A	L	2-09	100	43	60	85
	L	A	2-10	78	72	60	85
	H	H	2-02	100	62	100	84
	H	H	2-04	100	68	100	82
	A	L	2-06	89	32	60	82
	L	L	2-12	100	31	60	82
	A	H	2-08	100	46	100	81
	H	L	2-01	100	51	80	74
	L	L	2-17*	100	40	60	72
	L	L	2-15*	89	32	80	70
	L	L	2-14	78	23	60	62
	L	A	2-11	100	60	60	60
	H	L	2-03	78	65	60	58
	L	L	2-16*	89	17	60	52
	L	L	2-13*	100	43	60	27

A Comparison of Student Results in a Blended Learning Environment and a Traditional Whiteboard Environment.

Unit Standard 7499 (Use freehand sketching for graphic communication) was taught in a traditional manner; examples and sketching techniques were drawn and demonstrated on a whiteboard.

Unit Standard 7502 (Produce an instrumental orthographic drawing) was taught in a blended learning environment using a web camera to record demonstrations and display them live on a screen via data projector.

It can be seen in Table 22 and Table 23 that students achieved noticeably better grades in the blended learning environment. This was, in part, due to the teacher being able to work facing the class and maintain eye contact, a major contributing factor in reducing the amount of time wasted due to classroom management issues. The improvement in the classroom atmosphere encouraged students to

remain focused and produce a higher standard of work. The use of a camera also enabled replays or screen shots of the demonstration at any stage to help slower students advance in their work without time consuming delays while freeing the teacher to assist other students. While most students achieved better results in the blended learning environment, it was the top students who benefitted most from the use of video technology. While it was technically possible to provide videos for the students to complete their work at a later stage, the students who required this form of assistance the most, lacked the self-direction to exploit this possibility.

Table 22: Class 1 Results from a traditional whiteboard compared to results using video technology in a blended earning environment – Sorted by the Instrumental Drawing results.

	Traditionally taught sketching results compared with the results from Instrumental Drawings taught in a blended learning environment.						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Completed Sketches in %**	**Average Sketching Results in %**	**Completed Instrumental Drawings in %**	**Average Instrumental Drawings results in %**
Class 1	A	A	1-09	100	25	100	92
	H	L	1-01	100	50	100	92
	A	H	1-08	100	50	100	88
	H	H	1-02	100	40	100	87
	A	A	1-10	100	50	100	83
	A	H	1-06	100	48	100	82
	A	H	1-07	100	68	100	80
	H	H	1-03	100	20	100	77
	A	A	1-04	100	41	100	75
	A	A	1-05	100	50	33	75
	L	A	1-11	100	53	100	60
	L	L	1-12	100	30	100	20
	L	L	1-13	100	5	33	10

Table 23: Class 2 Results from a traditional whiteboard compared to results using video technology in a blended earning environment – Sorted by the Instrumental Drawing results. (Students identified by the school as having learning difficulties have an asterisk after their number)

	Traditionally taught sketching results compared with the results from Instrumental Drawings taught in a blended learning environment.						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Completed Sketches in %**	**Average Sketching Results in %**	**Completed Instrumental Drawings in %**	**Average Instrumental Drawings results in %**
Class 2	H	H	2-02	100	35	100	85
	A	H	2-05	100	60	100	82
	A	L	2-09	100	38	100	82
	H	H	2-04	100	50	100	77
	L	A	2-10	100	30	100	75
	A	L	2-07	100	43	100	72
	A	L	2-06	100	9	67	68
	H	L	2-03	100	20	67	63
	A	H	2-08	100	30	100	62
	L	L	2-15*	100	5	100	57
	L	A	2-11	100	33	100	53
	H	L	2-01	100	40	100	53
	L	L	2-17*	100	35	67	48
	L	L	2-12	100	19	33	40
	L	L	2-13*	100	26	100	38
	L	L	2-14	100	5	67	38
	L	L	2-16*	100	14	33	5

Student Work Patterns when using Online Learning Resources

The pilot project in 2008 also showed that students respond positively to the use of modern technology and preferred working on computers to working with paper resources. It was also shown that student results improved when working in an online environment although access to sufficient numbers of computers had been an on-going issue. Very few students had to share a computer in Class 1 due to the smaller class size while almost all of the students in Class 2 had to share a computer. Although most students coped well with the situation, it must be assumed that computer access influenced student achievement to an unknown extent.

The first two unit standards delivered online (Unit Standards 24352 and 24355) were completed by the students at their own pace which allowed the students to complete all of the activities and

worksheets they attempted to a high standard. The third and final unit standard to be delivered online (Unit Standard 24356) had a time constraint with the school year drawing to a close. At this point, student work patterns changed slightly, with some students completing work to a slightly lower standard and some not completing their work at all.

Table 24 and Table 25 compare student achievement and completion rates between the online resources and paper resources. Student achievement was considerably higher when using online resources. Students with higher asTTle grades and low overall attitude grades benefitted the most in this environment and the change in attitude in these students when using the interactive online resources was evident from the improved results. Table 24 and Table 25 also show that while the weaker students achieved better results when working online, they were more dependent upon teacher direction to complete their work.

Table 24: Class 1 - A Comparison of Average Student Results using Online Resources and Average Student Results using Paper Resources – (sorted by the online completion results and, within that, average online results).

	Results from paper resources compared with the results from online resources.						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Completed Paper Work in %**	**Average Paper Results in %**	**Completed Online Work in %**	**Average Online results in %**
Class 1	H	H	1-02	100	73	100	100
	A	H	1-08	100	79	100	100
	A	A	1-05	100	63	100	99
	H	H	1-03	100	49	100	99
	A	H	1-07	100	59	100	99
	A	H	1-06	89	76	100	99
	A	A	1-04	100	50	100	97
	A	A	1-09	89	78	97	100
	H	L	1-01	100	69	88	99
	A	A	1-10	89	68	86	95
	L	A	1-11	100	78	81	99
	L	L	1-12	100	30	77	98
	L	L	1-13	100	10	63	96

Table 25: Class 2 - A Comparison of Average Student Results using Online Resources and Average Student Results using Paper Resources – (sorted by the online completion results). Students identified by the school as having learning difficulties have an asterisk after their number

	Results from paper resources compared with the results from online resources.						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Completed Paper Work in %**	**Average Paper Results in %**	**Completed Online Work in %**	**Average Online results in %**
Class 2	A	H	2-08	100	46	100	98
	A	H	2-05	100	62	100	98
	H	H	2-04	100	68	100	97
	H	H	2-02	100	62	100	96
	L	A	2-11	100	60	97	96
	H	L	2-03	78	65	93	98
	A	L	2-09	100	43	79	98
	A	L	2-07	100	42	79	95
	H	L	2-01	100	51	77	95
	L	L	2-15*	89	32	77	95
	L	L	2-13*	100	43	77	94
	A	L	2-06	89	32	73	97
	L	L	2-12	100	31	71	94
	L	L	2-17*	100	40	68	85
	L	A	2-10	78	72	66	100
	L	L	2-16*	89	17	56	91
	L	L	2-14	78	23	43	88

A Comparison of Student Results in an Online Learning Environment and a Blended Classroom Learning Environment.

In the blended classroom learning environment time the pace of the learning activity was determined by the teacher, which put considerable time restraints on the students in the class. While the pace was often too slow for some of the faster students, the slower students were often under pressure and many failed to complete their work. Similarly, with the third and final set of online resources, many of these same students buckled under the workload as the term drew to an end, producing similar results to those in the blended learning environment. The results in Class 1 (Table 26 and Table 27) are more

consistent as the smaller class size allowed the students more computer time. The variation in the results of Class 2 is partly attributable to greater pressures on the students due to the larger class size and the poor work habits of a greater percentage of the students.

Table 26: A Comparison of Average Student Results using Online Resources and Average Student Results in a Blended Learning Environment – (sorted by the online completion results)

	Results from a blended learning environment compared with the results from online resources.						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Completed Blended Work in %**	**Average Blended Results in %**	**Completed Online Work in %**	**Average Online results in %**
Class 1	H	H	1-02	100	87	100	100
	A	H	1-08	100	88	100	100
	A	A	1-05	33	75	100	99
	H	H	1-03	100	77	100	99
	A	H	1-07	100	80	100	99
	A	H	1-06	100	82	100	99
	A	A	1-04	100	75	100	97
	A	A	1-09	100	92	97	100
	H	L	1-01	100	92	88	99
	A	A	1-10	100	83	86	95
	L	A	1-11	100	60	81	99
	L	L	1-12	100	20	77	98
	L	L	1-13	33	10	63	96

Table 27: A Comparison of Average Student Results using Online Resources and Average Student Results in a Blended Learning Environment – (sorted by the online completion results). Students identified by the school as having learning difficulties have an asterisk after their number.

	Results from a blended learning environment compared with the results from online resources.						
	asTTle High/ Average /Low	**Attitude** High/ Average /Low	**Student**	**Completed Blended Work in %**	**Average Blended Results in %**	**Completed Online Work in %**	**Average Online results in %**
Class 2	A	H	2-08	100	62	100	98
	A	H	2-05	100	82	100	98
	H	H	2-04	100	77	100	97
	H	H	2-02	100	85	100	96
	L	A	2-11	100	53	97	96
	H	L	2-03	67	63	93	98
	A	L	2-09	100	82	79	98
	A	L	2-07	100	72	79	95
	H	L	2-01	100	53	77	95
	L	L	2-15*	100	57	77	95
	L	L	2-13*	100	38	77	94
	A	L	2-06	67	68	73	97
	L	L	2-12	33	40	71	94
	L	L	2-17*	67	48	68	85
	L	A	2-10	100	75	66	100
	L	L	2-16*	33	5	56	91
	L	L	2-14	67	38	43	88

Summary of student results

Observation and results showed that students were more motivated to complete the online activities and worksheets to a high standard than any other type of task. A major contributing factor was the learning environment itself, as the students preferred working on computers more than any other environment. Other factors included instant feedback on their achievement and the competitiveness that this incurred, turning the challenge into a game. Given enough time, most students worked through the online resources at their own pace, achieving good results.

The blended classroom learning environment also increased student focus and assisted their understanding of complex tasks. The online resources were also able to be introduced and used as part of the classroom resources in a blended learning environment which expanded the application of the online resources while enhancing the blended learning environment.

Student claims that they would apply themselves better if they were allowed to do workshop practical were shown to be false in most cases. It became evident that the students who most loudly voiced this claim were more interested in doing no work at all.

While the use of technology was successful in enhancing the blended classroom learning environment and increasing student interaction and motivation in the online environment, it was only useful in as far as the technology also supported the underlying pedagogy of the Carpentry course. The use of technology for its own sake would have achieved very little. Even so, it did not bring about the expected changes in overall student achievement in the course.

Student perceptions of their own ability played a role in their achievement, especially the students in class 2. Of concern was the high number of students with poor attitude grades, bad work habits and low self-esteem which had the greatest negative impact on overall student achievement. The following charts highlight this problem. They combine all of the participant students into one group. The students are then sorted firstly by whether or not they passed the course (P = Pass, F = fail) and then by overall average achievement, measured as a percentage. Four of the students have been labelled "C" which means that they failed to complete the year's course by one unit standard. The failed unit standard was different for each one of them. The labels that have been assigned to each of the students can be interpreted using the following key (Table 28)

Table 28: Key to interpret student labels in Charts 25 - 28

Class No.	1	Class 1 – the smaller of the two classes.
	2	Class 2 – the larger of the two classes
Student No.	01 02 03 04 Etc.	01 – 17 = The student's position in their respective class when the class is sorted by their Yr. 10 asTTle result. Student 01 in either class has the highest asTTle result whereas Student 13 in Class 1 and Student 17 in Class 2 have the lowest.
Yr. 10 asTTle	H	Students with an overall asTTle result over 85%
	A	Students with an overall asTTle result of 75% to 85%
	L	Students with an overall asTTle result below 75%
Attitude	H	Students with an attitude grade of 75% and above
	A	Students with an attitude grade of 51% - 74%
	L	Students with an attitude grade of 50% and below
Ethnicity	P	New Zealand Pakeha
	O	Overseas European
	M	New Zealand Maori
Course Completion	P	Pass – All compulsory Unit Standards Completed
	C	Close – 1 compulsory unit standard short of completion.
	F	Fail – 2+ compulsory Unit standards short of completion.
Example: **2-05-A-H-O-P** Class **2** – Student **05** – **A**verage asTTle – **H**igh Attitude – **O**verseas European – **P**assed/Completed Course		

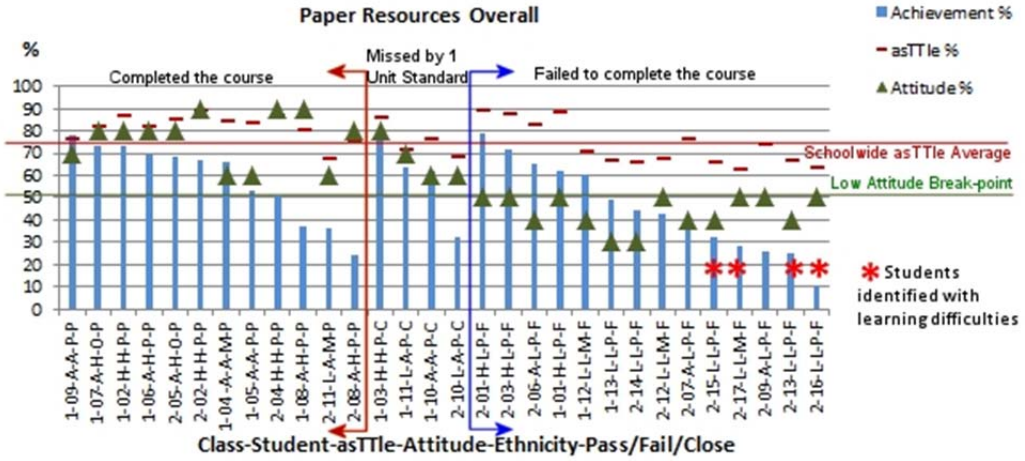
The following charts show that none of the students who achieved overall attitude grade at the breakpoint of 50% or lower completed the course. These students all failed to complete two or more compulsory unit standards in the course. Another group of four students failed to complete just one of the compulsory unit standards. All of the students in this second group and the group who completed the course had an attitude grade at or above the school average. Again, the students identified by the school as having genuine learning difficulties have been marked with an asterisk (*).

Figures 31 – 34 show that a high asTTle result in Year 10 was no guarantee that a student would achieve good results just as a low asTTle result did not automatically indicate that the student would achieve poor results. However, it is evident that all but one of the students who completed the course had average to high asTTle grades. Of the students who missed completion by one unit standard, one had a high asTTle grade, one an average grade and two had low asTTle grades. From the fourteen students who failed to complete the course, only three had high asTTle grades as opposed to eight with low asTTle grades.

The charts also show that a low asTTle grade is often accompanied by a low attitude grade and that even students with high asTTle grades were more likely to not complete the course if they had a low attitude grade.

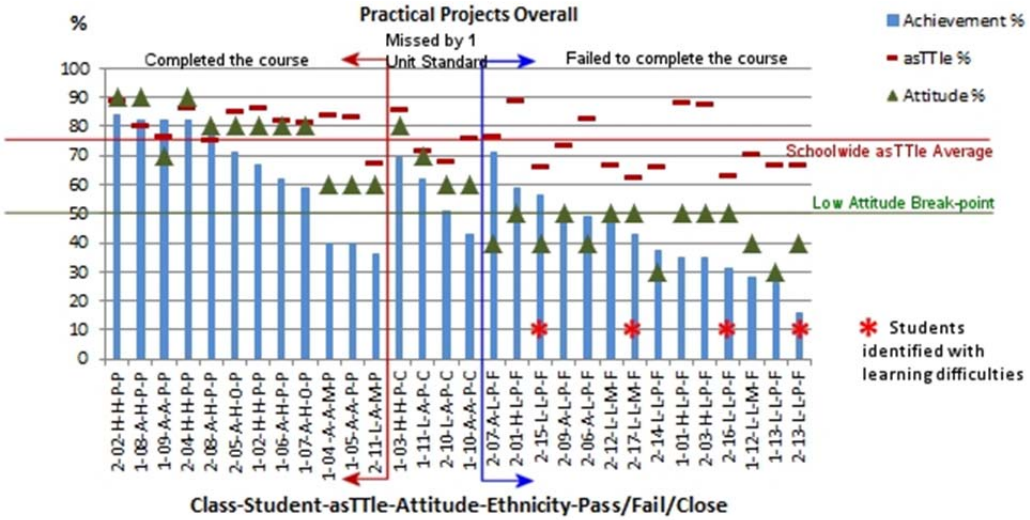
The average results for paper resources (Figure 30) form the benchmark for gauging differences in student achievement, used to indicate student engagement. Taking the averages for the whole observation period, effectively removes the fluctuations from individual activities to reveal overall trends in student work patterns. In all three groups (Pass/Close/Fail) there were students who achieved poor results. Generally, the students who achieved the best results were those with average to high attitude grades and /or average to high asTTle grades.

Figure 30: Overall average student results from paper resources - Sorted first by course completion then by result.



Contrary to student claims, some students achieved lower grades and had lower completion rates for their practical work than their paper work (Figure 31), for example; Students 2-01, 2-06, and 1-01. Of the students with learning difficulties, Student 2-15 improved the most when working in the workshop while Students 2-13 and 2-16 failed to complete nearly half of the practical work.

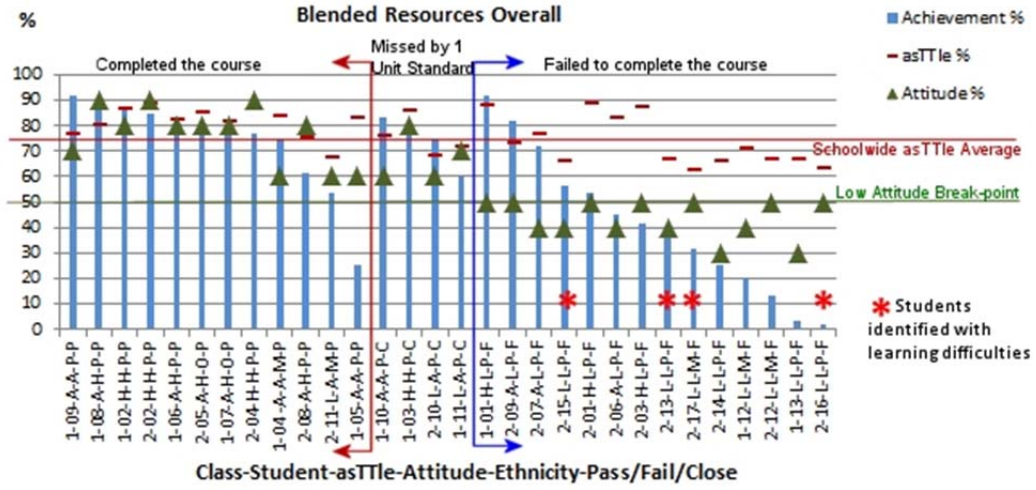
Figure 31: Overall average student results from all practical projects - Sorted first by course completion then by result. (Students identified by the school as having learning difficulties have been marked with an asterisk)



The students who benefitted most from the blended learning environment (Figure 32) were the students with average to high attitude grades. From the students who completed the course, student 1-05 achieved lower grades. The rest achieved similar or better grades than when the course was being

delivered using a traditional whiteboard. While the differences in student results are not spectacular by themselves, it must be taken into account that these students had completed the work in one week that had taken three weeks in previous years which benefitted other areas of the course.

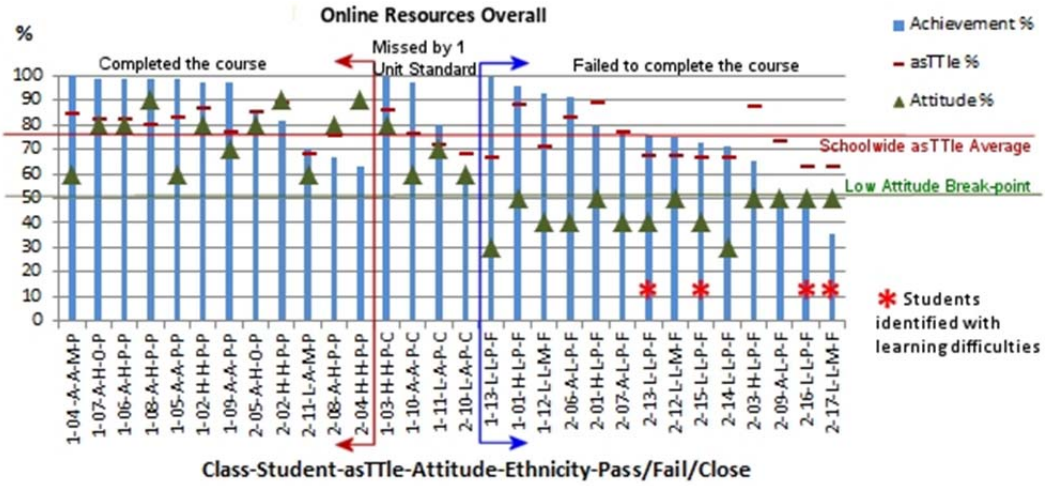
Figure 32: Overall average student results from a blended learning environment - Sorted first by course completion then by result. (Students identified by the school as having learning difficulties have been marked with an asterisk)



The online resources showed the most improvement across the widest range of student ability and attitude (

Figure 33). Sixteen of the thirty students (53%) had average grades between 80% and 100% and eleven students (36%) had grades of 90% and over as opposed to four students (13%) achieving an average of 80% on paper. The students to benefit the most in this learning environment were the students with low asTTle and low attitude grades. The positive response of the students to the interactive online resources was due to the increased quality of collaborative work amongst students, the instant feedback provided by the resources themselves and the competitive atmosphere created by the built-in timers in the resources. These factors combined to effectively turn the work into a sort of game for the students, changing the students' attitudes towards the work and improving results.

Figure 33: Overall average student results from online resources - Sorted first by course completion then by result. (Students identified by the school as having learning difficulties have been marked with an asterisk)



Even in their practical work, only five students managed to achieve an average of around 80% as opposed to seven students with an average of 100% using the online resources.

This highlights a number of things; firstly, the students are capable of working at this level in this subject, secondly, that under the right circumstances they can be motivated to succeed and thirdly, that it is possible for them to change their attitude towards theory work. This can be seen from the results of students such as 2-13, who had been in the bottom two students throughout most of the course and yet completed 77% of the online work with an average score of 94% and to achieve 72% overall gives an indication what can be achieved given the right motivation under the right circumstances.

The following chapter draws together the findings of the qualitative and quantitative data and discusses these in the light of relevant literature.

4.3 Reflections on Participatory Action Research Findings

While the prime focus of this study was to observe student engagement with the interactive online resources in this course, using the cyclic nature of PAR to continue the resource development, it became apparent during the evaluation of the data that the critical reflection in each phase of this PAR study influenced the way in which other areas of the course were taught. In the first three weeks after the start of the observation period (02/03/2010), the reflective journal entries revealed important details showing that student achievement was being influenced at least as much by poor learning habits and work ethics as by ability (Reflective Journal entries 12/03/2010, 16/03/2010, 26/03/2010). This allowed the focus of the teaching to shift to address these issues directly in class. It was also identified (Reflective journal entry 14/05/2010) that many students were unaccustomed to constructing or adapting things for themselves which put them at a disadvantage when trying to conceptualise projects in three dimensions. The continued development of the 3D animations enabled many of these students to visualise the project construction more clearly. Observation had also revealed that while the camera and data projector had been initially introduced to teach mechanical drawing to overcome classroom management issues that arose when the teacher was drawing on the board facing way from the class, the camera also showed the demonstration from a similar perspective to the way the students saw their own work and on the same equipment which inadvertently overcame the previously unrecognised issue that some students had in relating what was on the whiteboard to what they saw in front of them on the desk (Reflective journal entry 10/09/2010). Many of the adaptations to the way this course was taught were being implemented as part of an on-going process to streamline the delivery. As a teacher, these changes were made to address issues such as student ability and classroom management issues. While casual observation would have confirmed that the changes had triggered the desired response from the students, without the conscious observation and on-going record of the field notes and entries in the reflective journal, many underlying issues regarding student engagement and achievement may have gone unnoticed and remained undetected barriers to student success.

The changes to teaching were designed to encourage student engagement. While student results improved for individual activities, indicating that the strategies for encouraging student engagement were successful, overall student results for the course changed little. Analysis of the data indicated that many of the students who failed to pass the unit standards offered in the course were unused to success and would frequently be off-task after only short periods of sustained effort (Reflective journal entries 04/06/2010, 27,08,2010). These students often mentioned they felt they had “earned” a break and were rewarding themselves for their efforts. In contrast, successful students tended to reward themselves with a break only when the activity or task was completed. This reinforced

observations made previously (Reflective Journal entries 12/03/2010, 16/03/2010, 26/03/2010) that work ethic and learning habits were major contributing factors to student achievement.

Having recognised that the introduction of innovative teaching methods can influence student engagement and thereby influence student attitudes towards specific areas of the course, the challenge remains to instil learning habits which enable the students to work towards completion of their tasks. While much of the theory can be adapted for online delivery, finding innovative ways to engage students in their practical work or aspects of the course that still require paper may be a greater challenge. Many of the issues that were revealed concerning student engagement when working with paper resources were found to be present in other areas of the course that had not been considered problem areas, such as practical work. This insight opens up questions about student engagement and self-management for the teacher/researcher and his colleagues to explore in the future.

Chapter 5. Discussion, Conclusion and Recommendations

Overview

This chapter will briefly summarise the research findings, reflect on the methodology, and look at the ICT competence required by both teachers and students when implementing a blended learning environment with an online component. Student engagement with the blended and online components and the underlying pedagogy will then be summarised followed by a brief analysis of how the students reacted to the assessment components of the study and the pedagogy behind it.

This study seeks to investigate student engagement among high school Carpentry students when working in an online learning environment by comparing student results with the results achieved in a blended learning environment and traditional paper resources.

Data was gathered from the student asTTle results from the previous school year. In addition, the ethnicity and gender of the group was investigated to compare the participants to the regional and national populations in New Zealand. Student achievement in an online learning environment was analysed and compared to the same student's achievement in a blended learning environment and a traditional learning environment to give an indication of changes in student attitude. Data gathered from the New Zealand 2006 Census, Statistics New Zealand and the Ministry of Education statistics revealed that the demographics of the participants was similar to both local and national statistics in gender and ethnicity while the asTTle results from the previous year showed that the students' academic achievement was representative of the school population for their year level. However, the two classes were dissimilar; one of the classes was larger and had a higher proportion of students with a poor academic record.

This study compares two dissimilar groups of students under the same conditions with the same teacher. Although comparisons were made between the two groups, the primary means of comparison was measuring individual student achievement in an online environment against the student's own achievement in a variety of different learning environments to observe changes in student engagement.

The purpose of this study has been to investigate student interaction with online theory with the intention of improving student performance in Carpentry theory.

During the study it was observed that it was possible to capture student attention through the targeted implementation of modern technology and that student performance in these areas could be improved.

Students became more result-oriented as the feedback given by the online resources allowed them to know their results immediately, while the inclusion of features such as a timer added an element of competition to the activities which further increased student engagement by allowing the students to compare their performance and times against those of their classmates.

5.1 Discussion

Summary of Research Findings

The students in this study responded well to the use of technology in the classroom/workshop and worked to a higher standard in an online environment than on the equivalent paper resources (Reflective Journal entry 24/09/2010). The findings show that the greatest improvement in student achievement over the widest range of student ability was observed when traditional paper theory resources were replaced by interactive online resources. Past teaching plans also revealed that these results were achieved in shorter time-frames than previously.

Both the teacher and the students benefitted from the use of communication technology in the workshop /classroom. One major benefit was a substantial reduction in the amount of time taken to display and deliver content which allowed more time for open discussion and freed up valuable teacher time to be used in other areas of the course such as practical work; another area where students with a low asTTle grade and/or poor attitude struggled to achieve satisfactory results.

Although most students showed some improvement in their grades, the students who benefitted the most from working in the blended and online learning environments were those with an average to high attitude grade throughout the year. These students were more open to trying new techniques, more open to suggestion and less likely to be adversely influenced by peer pressure.

While the implementation of communication technology on its own was not shown to directly improve grades or student attitude, the online learning resources were shown to help some of the academically weaker students overcome their learning difficulties and lessen their aversion to written theory.

The increase in student-centred pedagogy promoted active enquiry among the students and the immediate formative feedback directly from the resources guided the students through their work and helped them understand difficult concepts so that they were able to achieve to a higher standard than would otherwise have been the case with minimal teacher intervention. The built-in timer and instant results from the self-marking resources maintained high student engagement giving the activities a game-like aspect. In addition, groups of students added an unexpected competitive element by vying

with each other to achieve the highest results in the quickest time, often repeating an exercise more than once to achieve a better result than a classmate. Students who continued to fail would then seek guidance from their peers to find the correct information which fostered collaborative support for these students which had previously been lacking in the traditional paper environment. As the students became more familiar with the online learning environment, the role of the teacher became one of facilitator, solving technical issues as they arose and providing the students with a framework for the concepts and theories they were learning.

However, while the results in both the blended learning environment in the classroom and the online environment on Ultranet were encouraging, with improved student achievement in individual activities in both environments and a reduction in student management issues, weaker students still failed to complete all of the required activities to pass the unit standards.

Reflection on Methodology

This case study was undertaken with a Participatory Action Research (PAR) approach (Williams, 2007), the strength of which lies in its cyclic nature (Kemmis & McTaggart, 1988) and flexibility. Two mini cycles (Phases) of continued development of the interactive online resources were possible which enabled the immediate implementation and testing of changes and improvements resulting from feedback and suggestions from the students during the observation sessions and the informal video discussions with the students at the end of each phase.

Intimate knowledge of the students and access to relevant school information allowed the researcher/teacher to examine the case in depth and within a “real life” context. In this case, access to report information and student profiles in conjunction with a long-term relationship to many of the students provided a balance to the observations made in both the online and blended learning environments. The high level of contact allowed observation student behaviour in class for most Carpentry lessons while unrestricted access to student achievement results allowed a depth of insight that may not have been possible as an external researcher. In addition, the multiple case study design allowed comparison of two classes of different sizes and ability levels to be observed using the same parameters such as same teacher, the same classroom environments and identical resources, allowing greater in-depth analysis of the findings.

The qualitative data for this study was obtained through open observation and the teacher’s field notes. Events and impressions were noted and recorded as they happened with no constrictions on the information recorded. This allowed events that may have seemed insignificant at the time of the research design to be noted and their significance analysed at a later stage. Examples of this included:

noting how students failed to relate knowledge gained in other curriculum areas to their practical application in Carpentry, the difficulties many students had with the concept of alphabetic order and the anomaly found in the way some students were reading and scanning paper resources which was similar to the way they read a computer screen. Observations such as these were made possible by the long-term intimate relationship to the students that the teacher/researcher had, one of the strengths of the role of the participant researcher, and, at the same time, one of its greatest weaknesses. The possibility that the observations may be biased through this close relationship to the students and/or blind spots as a teacher must be taken into account. It became evident during the evaluation of the reflective journal, that, although this study was built upon a previous pilot study, many of the underlying causes for the lack of student engagement had not been, or had been wrongly identified. One example was the general assumption, on the part of the teacher/researcher, that students would know how to improve their own work ethic or learning strategies when informed of any shortcomings because of the school-wide policy of teaching the students about learning (ako). It became evident throughout the year that this was clearly not the case and that students required specific coaching to overcome many of these difficulties. In this instance, an intervention had already been put in place by the teacher/researcher to teach the students some of the motivational basics of NLP as an extension to the school policy.

This study has highlighted the importance of reflective practice, particularly for the teacher/researcher. In this sense, PAR aligns itself well with what teachers tend to do in their daily practice: testing new teaching and learning resources and modes of delivery, observing the outcomes, reviewing and refining teaching methods (Kemmis & McTaggart, 1988). The value of PAR is that it provides a flexible structure to a process that is mostly trial and error, providing the process with the rigour and structure to inform the development of modes of delivery and resources. In addition, the structure of PAR lends itself to guiding collaborative efforts among groups of teachers in a common direction while maintaining the flexibility to allow each of the teachers to adapt the outcomes of each cycle to their own practice. This flexibility will enable programmes to be developed to develop courses which encourage student engagement both within and across curriculum areas.

During the course of this study a large amount of data was collected from statistics on achievement, ethnicity and gender sourced from the New Zealand Census 2006, the Ministry of Education and Statistics New Zealand websites and student results from the course and previous asTTle tests.

Issues

Three main issues emerged from the analysis provided in the previous chapter. Firstly, as noted in other studies (Davis et al., 2010; Luckin et al., 2009; Wright, 2010; Zaka, 2012), although students preferred working with the interactive online resources over the equivalent paper resources, their ability to use the tools available to them through the use of ICT is very superficial (Reflective Journal entry 31/03/2010, Observation sheet 12/07/2010). Secondly, while the use of computers overcame many of the problems students faced with presentation and spelling in their written work (Fletcher et al., 2011), the poor literacy skills of some students adversely affected their performance in all areas of the course, including their practical work (Reflective Journal entry 04/06/2010). Thirdly, the use of ICT, in itself, did not influence overall student achievement. While students achieved high grades with the interactive online resources they attempted, poor work habits (Bolstad & Gilbert, 2006; Garrison, 2011) often saw students not completing all of the performance criteria required for successful completion of the unit standards being assessed in the course (Reflective Journal entry 17/09/2010).

Student engagement with ICT in the Classroom

During practical workshop lessons, 3D animations were displayed via data projector, showing all of the basic instructions necessary to complete each step of the current project. This is an approach that has been effective in teaching trade skills at polytechnic level (Davis et al., 2010). Once students had been shown how to obtain specific information from the computer animation, they often referred to the screen to aid their work and answer basic questions. In most cases, the written instructions in the students' exercise books were not referred to at all, even though their books and the animation contained the same information. Similarly, students preferred to research information on the computer where they were able to take advantage of features such as search functions when reading electronic documents or the search engines on the Internet to discover relevant information as opposed to browsing through paper resources and books (Fletcher et al., 2011) even though the information contained within the resources was identical. A change in student attitude and focus was observed when working with electronic and online resources. Students no longer asked for answers, instead, asking how they should obtain the correct answer for themselves, many showing signs of developing the independent learning skills that are so important when learning online (Bolstad & Lin, 2009; Garrison, 2011; Zaka, 2012). This change highlighted an important issue facing students when they work online: the almost unlimited access to information. Students must not only find the information they require within the masses of information available to them on the Internet, they must also determine whether the information current and correct. This has also been confirmed in studies by

Hase and Ellis (2002) which emphasise that the skill of how to find and verify information is one of the most important online skills that today's independent learners require to prepare them to succeed in an online environment. The students in this study who had learned to use search engines and who took the time to cross-reference the material they found required less teacher input and were more independent in their learning than those who had not learned these skills. Zaka (2012) found that student ability to work independently was also influenced by the degree to which they could resist external distractions.

An inadvertent side-effect of the self-marking facility on the interactive online resources, combined with the built-in timer was that students were encouraged to achieve better grades in a shorter time than their classmates, supporting a competitive spirit that evolved in the computer pod. Davis Fletcher and Absolom (2010) noted a similar competitiveness in polytechnic students working with a building site simulator which also used scores and a timer. The use of scores and timers or time limits can also be found in many computer games. In their review of the arguments surrounding claims about the learning preferences of the 'digital generation', Bennett et al.(2008) state that there is no clear evidence that the interactivity found in most computer games is directly applicable to learning, however, Dede (2005), in his research into educational technologies and student learning styles in higher education, indicates that there is some evidence to suggest that modified game-based approaches can support effective learning through mediated interaction. Bennett et al.(2008) point out however that computer games are considerably more popular amongst males than females and as a result, gaming approaches to education may not equally cater for all students. In this case, gender was not a factor as all of the students taking part in the study were male.

Some students in this study were found to have an aversion to working with paper resources because of reading difficulties and poor presentation and handwriting skills. This was often exacerbated by a lack of practice through continued avoidance. The findings show that, as in other studies (Fletcher et al., 2011; Zaka, 2012) working with the computers removed some of these barriers to learning and enabled these students to achieve good results in areas where they would have otherwise struggled. These students related better to the online medium than to their paper resources with the result that they were more willing and able to attempt the work set for them.

Pedagogy

Student Centred learning and Motivation

In this study, communication technology was used in four distinct ways; firstly in the classroom/workshop as a teaching tool to present and use the online learning environment, secondly, to replace the whiteboard during demonstrations of theory and practical work using a web-cam, thirdly, as an independent source of information for the students through the use of computer animations and finally, in the computer pod as a learning tool where the students worked directly with the online resources.

The use of recorded web-cam demonstration, computer animations and interactive online resources allowed the teacher to step aside to act as an advisor and facilitator while students actively discussed either the work they were starting or the work they were doing. This active student engagement in the learning process and the shift in the role of the teacher to one of facilitator has been noted in other studies and reviews (Andreotti & de Souza, 2008; Gilbert, 2005; Luckin et al., 2009; Wright, 2010; Zaka, 2012) and appears to be a natural process in the implementation of a blended learning environment. The targeted use of ICT in the classroom freed the teacher to move about the class assisting individual students while the use of a web-cam during demonstrations of technical drawing and practical work enhanced the face-to-face environment and allowed the teacher to maintain eye-contact with the class. These strategies effectively avoided the "Death-by-PowerPoint"(Kapterev, 2007) scenario where the data projector replaces the blackboard, whiteboard or overhead projector and the classroom becomes a lecture theatre where the students are little more than passive recipients of information (Gilbert, 2005; Wright, 2010, 25; Zaka, 2012; Zhao & Frank, 2003). Furthermore, Alexander and Boud (2002) argue that through the unreflective use of computers as a substitute for books, much of the potential of online learning is lost. Certainly, in this study, the least effective resources were those that most closely resembled traditional paper resources such as Word or PDF documents. Although these resources were provided as reference documents, their provision on Ultranet did little to enhance the learning environment and did not increase student engagement to any noticeable degree.

Catering for students who are not independent learners

Observation showed that, while the students enjoyed working with the interactive online resources, many of the weaker students (those with low asTTle and/or attitude grades) appeared to be reliant upon the face-to-face sessions (Pullar & Brennan, 2008) to obtain important feedback and direction to the course because they lacked the learning skills necessary for autonomous, self-directed, entirely web-based learning. Stacey and Gerbic (2009, 8, 304) note three advantages of using a blend of face-

to-face sessions in conjunction with online learning that apply to this study and the student/teacher interaction, especially for students who are “at risk”. The first advantage is that rapid feedback can be provided to expand upon automated responses integrated into the interactive online resources. Secondly, these learners can be reminded of course expectations and learning outcomes and helped to prioritise their work and keep schedules. Finally, foundations can be laid for new activities, topics and concepts with or without the aid of technology to help give the students the assurance of knowing what to do once they resume their work online.

This student dependence on the teacher’s support was also noted in a recent case study by Parkes, Zaka and Davis (2011) showing that for secondary students whose instruction is still conducted primarily in the traditional way, the time spent online with the on-site support of a teacher gives them a chance to gradually familiarise themselves with independent learning.

The alternation between individual study, classroom activity and online work alleviated the need for high levels of individual student autonomy, providing more support for the weaker students than if the theory component of the course been taught entirely online or in class e.g. (Parkes et al., 2011; Stacey & Gerbic, 2009; Trentin & Wheeler, 2009). This blended approach combined the enhanced learning possibilities of the online environment with the socialisation opportunities of the classroom (Powell, 2011).

Assessment

The Carpentry theory for this study presented either in the blended classroom environment or online, was directly or indirectly concerned with the assessment of the students. The Instrumental Drawings delivered in the blended learning environment were completed as part of the course requirements and subsequently assessed. As this activity was taught face-to-face, feedback for observable learning outcomes was available directly from the teacher as the lessons progressed (Oosterhof, Conrad, & Ely, 2008). Although teacher interaction was required, the use of the blended learning environment allowed the teacher/researcher the freedom to comment on student’s work individually during video replays of the demonstrations. The findings in this study show that even a few minor alterations in delivery through the use of ICT and different media can increase learner satisfaction dramatically, with concomitant effects on the student engagement and learning (Bersin, 2004; Dede, 2008). A recent case study by Powell (2011) investigating current e-learning initiatives and projects for students in New Zealand secondary schools, also found that this combination of face-to-face learning and modern communication technology was effective for maintaining high levels of student engagement.

The self-marking facility of the interactive online resources contributed noticeably to a change in student behaviour, a finding that is similar to that of Davis et al. (2010). Even academically weaker students worked toward successful completion of these online activities and worksheets, using the tools available to them such as spelling and grammar checkers, "cut and paste" and search engines to obtain the correct answer (Fletcher et al., 2011) where previously they would use anything to fill in the gaps on the pages of the equivalent paper resources. Many of these students had rarely, if ever, referred to paper resources and had great difficulty searching and targeting relevant content for their assessments, an important basic skill that all learners need to master (Hase & Ellis, 2002). The access to electronic documents and online resources enabled these students to take advantage of the capabilities of modern technologies and work independently towards the successful completion of their assessments with less teacher involvement (Oosterhof et al., 2008).

Student Achievement

The most noticeable improvement in student achievement was seen when communications technology was introduced to address known pedagogical issues that occurred in a face to face situation or where student reluctance to engage with paper resources was directly targeted by developing online learning resources.

This study used the capabilities of modern technology to enhance the students' capabilities to address and sort through large quantities of information, effectively eliminating the one of the problems these students had with paper resources. This did not and was not intended to improve their reading skills rather; through this focused use of technology they were able to work independently finding relevant information to help them with their studies. Hase and Ellis (2002) observed that these skills were among the most important for today's online learner. Student achievement was raised from the twenty to forty percent using paper resources to an average of ninety to a hundred percent for almost identical activities delivered through an online medium.

The student perceptions that work on the computer would be easier than working with paper led to greater satisfaction and engagement with the online resources. Another contributing factor was the natural interest that these boys had in any technological devices. When combined, these factors appeared to increase the level of engagement and enabled the students to approach their work without negativity.

5.2 Conclusion

The findings of this study indicate that the introduction of online resources into a course does not necessarily affect overall achievement. Although the students involved in the study could be engaged through the use of communications technology when it was used to address specific identifiable issues, raising student achievement in these specific areas, it was also recognised that the students need to engage with the subject of Carpentry as a whole if overall results are going to improve.

The analysis of student results from the previous year shows a correlation between poor asTTle results and the attitude of the students towards their schoolwork in general. Furthermore, those students with poor overall attitude grades were shown to be more likely than students with a high attitude grade to not complete their work and fail the unit standards in the course. Unless the attitude/work-ethic of the students with lower asTTle grades is addressed at an early stage of their learning development, it would appear that the introduction of technology into the classroom and the use of online learning resources at high school level are unlikely to affect overall student achievement.

Had all the theory for this course had been delivered in the blended and online environments, the resulting savings in time through faster delivery and reduced marking load could have resulted in more time in the workshop for practical work and could have permitted more students to pass the course. Certainly, this is one area where further research is recommended.

Limitations

As can be seen from the extensive analysis of student results, it had been considered as important by the teacher/researcher, that evidence based upon tangible, measurable results was gathered in order to make differing levels of student engagement visible. While this data was useful in the further development of the interactive online resources, on analysis, this quantitative data was found to be less crucial to the findings on student engagement than expected. While quantitative in nature, in order to draw conclusions about student engagement the data was analysed in a qualitative manner, drawing on the experience and observations of the teacher/researcher for interpretation. Through this process, areas have been identified that would require serious consideration in future studies. In hindsight, it is apparent that the focus around the development of the online interactive resources limited the potential for PAR to address issues as they arose. Many of the inadvertent findings revealed in the analysis of the researcher's reflective journal were acted upon in the normal course of teaching practice as adaptations of teaching methods and delivery. Once these underlying issues regarding student engagement had been identified, the remaining PAR cycles may well have been put to better use addressing these issues rather than in the continued development of the online resources

in order to more fully address the research question regarding student engagement. During the observation period, the teacher/researcher had not fully realised the extent to which PAR can throw ideas back and change the content of a research project while still remaining focussed on the original research question.

As indicated in the methodology and previous chapter, the teaching decisions and adjustments made during the observation period were often made in response to the need to keep things going for all of the students within a pre-defined time-frame. The analysis of the researcher's reflective journal revealed that while many of these decisions and adjustments were shown to be successful in engaging students, the assumptions that lead to these decisions were shown to be inaccurate. The reflective journal also revealed a bias by the teacher/researcher to find ICT related solutions when confronted by student engagement issues. While these solutions were successful in increasing student engagement during the observation period, no account was taken of the possibility that the newness of the solution might have been primarily responsible for this increase.

This study did not explore the extent to which, the novelty value of the mode of delivery influenced student engagement as revealed in the literature review. This was partly due to the short time-frame of the study and is a factor that should be taken into consideration in future research. While some students were found to be off task in the later stages of the observation period, it was not identified whether this was attributable to general distraction by faster students surfing the internet, that not all of the interactive resources were available to the students or that the students had become accustomed to the learning environment and old learning habits were resurfacing. This, too, is an area that could have potentially been better addressed by a change of focus away from the online resources to a focus on the student learning experience after the first PAR cycle.

Summary

To use ICT successfully, it has been shown that a need must be identified where ICT is the best option. Although a lot of emphasis is placed upon using modern technology to its full potential, often clever solutions are being provided for problems that do not exist while the pedagogy which should be driving the development of the course is overlooked. The redesign of part or all of a course must firstly address the educational principles behind the course; increasing the likelihood that the correct technological solution will be chosen.

The use of a blended learning environment, where ICT is used to enhance face to face learning, has been shown to engage high school students more than working individually online. This appears to be partly due to the age and inexperience whereby the students lack the motivation and the study skills to

work on their own. These students benefit greatly from the face to face contact with a teacher to provide the direction and stability for them to achieve good results in a blended online environment.

In this study it was also recognised that the students often did not possess the necessary skills to use their computers as learning devices and that their knowledge of communications technology and its application in any situation was often very superficial. As a result, it is recommended that all instructions, learning intentions and outcomes be very specific otherwise the resulting lack of direction amongst the students was found to quickly negate any benefits derived from offering the theory online.

While it may be an advantage for educators to be competent with the basics of ICT, it is recommended that an analysis of the pedagogy behind their teaching should be the starting point. When developing resources for online delivery it was shown that even simple resources encourage student engagement when the activity accurately targets the skills being assessed and the students feel that the activity is worthwhile and meaningful. However, it was also recognised that the more that the electronic resources resembled the paper resources from which they were derived (e.g. PDF and word documents); the less effective they were at stimulating student engagement. This reinforces the findings of many studies which indicate that the implementation of an online environment consist of more than just digitising the paper resources for electronic display rather; educators need to be clear about what they are trying to achieve through the use of ICT and what they are trying to assess as the novelty of working with computers is limited.

It was also noted that the implementation of timers on the self-marking online resources introduced competitive element to the learning and assessment that was not present when these students worked with traditional paper resources. The immediate feedback during the assessments also encouraged the students to work towards achievement rather than just completion of the worksheet. As the tests allowed students to refer a variety of reference sources, including books, the internet and each other, the collaboration which took place encouraged group achievement and peer learning which had also been absent in the traditional environment where the students often just copied the first best answer with little regard as to whether it was correct or not. Putting traditional face-to-face courses on line, however, is not a simple exercise and requires a different approach to the role of the teacher and the concept of how the course is developed and delivered. It is here that the strengths of Participatory Action Research are revealed. The cyclic nature of this approach allows teachers to reflect and adjust their teaching practice according to the responses of the group.

To this end, consideration needs to be given to support and professional development for teachers. Perhaps the redesign of courses could be carried out by a team rather than individuals so that the workload can be distributed and teachers can learn from the activities of developing and testing the resources they develop. Ideally, those who are entrusted with the task of making this transition should be encouraged to do so by an accompanying reduction in their teaching load and classroom sizes, especially during the initial phases while they gain experience and expertise and develop the resources.

Finally

This study was carried out to address the research question:

How do my Carpentry students engage with the interactive online resources in a blended learning environment, which replaced the course resources on paper?

It was shown that the students responded with high levels of engagement and achieved excellent results in their theory work when working on computers. However, these encouraging results did not equate to better overall student achievement in the subject of carpentry.

This study identified poor reading and writing skills, poor presentation skills, attention disorders and dyslexia as contributing factors for the lack of achievement for some of the students. These factors will also influence the level of tertiary education these students are likely to achieve, their level of employment and income.

The lack of relevant literature regarding the use of blended learning environments for secondary school students in vocational subjects was acknowledged in the literature review. It is recommended that further research is undertaken to investigate how blended learning could be used to overcome some of the challenges that these students face in the education system.

Recommendation for Future Research

While there is a growing body of research investigating adult tertiary and vocational with literacy and numeracy problems, it is also clear that these problems are evident at a much earlier stage and could potentially be addressed at this level through the further development of innovative modes of delivery.

In the school in which this study took place, the use of ICT is being widely implemented and, while the findings of this study are not generalisable, the approach to the development of courses, resources and modes of delivery may well be applied to other areas opening the possibility of investigating student attitude and engagement in the wider school community.

It was identified that PAR could also be successfully used as a research tool to aid in the development of innovative teaching practice in other areas of the carpentry course such as the practical projects and areas where paper resources continue to be used as well as to investigate how to encourage students to apply learned theory in practical situations.

This study revealed that students responded positively to the interactive online resources and that these types of innovation lead to an increase in student engagement. The focus of future research should possibly address the question of how to improve overall student achievement in a vocational course where only part of the course can be delivered online and many traditional aspects of the course need to be retained.

Glossary

Activity	Work for the students contained within the teaching resources provided by the BCITO or an online adaptation of the paper teaching resource. These are provided primarily for formative assessment.
asTTle	stands for Assessment Tools for Teaching and Learning. It is an educational resource for assessing literacy and numeracy developed for the Ministry of Education by the University of Auckland and provides teachers, students, and parents with information about a student's level of achievement, relative to the curriculum achievement outcomes, for levels 2 to 6 and national norms of performance for students in years 4 to 12.
Attitude	In this study, the term “attitude” is used in its common sense as an over-arching term to describe the visible combination of class participation, work ethic, learning habits and classroom behaviour. It is not intended to describe an inherent quality of a student over which the teacher has no control
BCITO	Building Construction Industry Training Organisation
Cycle	The complete cycle of the 2010 PAR project
Decile	The decile indicates the socio-economic group that the school catchment area falls into. A rating of 1 indicates a poor area; a rating of 10 a well-off one.
Hot Potatoes	A freeware suite of development tools for developing interactive resources ready for publishing on the web.
HTML	Hyper-text Mark-up Language is the authoring language used to create documents on the World Wide Web
ICT	Information and communication technology
LLN	Literacy, language and numeracy
LMS	Learning Management System - also referred to as OLE (Online Learning Environment) when network or web-based.
NCEA	New Zealand's National Certificates of Educational Achievement (NCEA) are national qualifications for senior secondary school students.
NLP	Neuro-linguistic programming is an approach to psychotherapy chiefly concerned with the relationship between successful patterns of behaviour and the subjective experiences (esp. patterns of thought) underlying them and seeks to educate people in self-awareness and effective communication, and to change their patterns of mental and emotional behaviour.

NZQA New Zealand Qualifications Authority

OLE Online Learning Environment - also referred to as LMS (Learning Management Systems). Some of the more common ones are Moodle, Blackboard and Ultranet

PDF Portable Document Format

Phase Stages of PAR data collection over a term and equivalent to mini cycles within the 2010 action research project.

Project Practical work undertaken in the Carpentry class as opposed to theory. Three from six projects have been selected for their ability to highlight applied theory.

Record of Work Entries made in the back of the students' exercise books outlining their goals, outcomes and the analysis of each period.

RoW Record of Work

Task Work set within the Ultranet Online Learning Environment. Each task page provides instructions, links and access to the activities and worksheets required by the students for a particular Unit Standard.

TKI Te Kete Ipurangi – the knowledge basket – is New Zealand's bilingual education portal. An initiative of the Ministry of Education, it provides New Zealand schools and students with a wealth of information, resources, and curriculum materials to enhance teaching and learning, raise student achievement, and advance professional development for teaching staff and school managers.

Ultranet The Online Learning Environment currently being trialled at the school and due to be implemented school-wide in 2011.

Unit Standards Assessable units of work towards NCEA

Worksheet Work for the students contained within the teaching resources provided by the BCITO or an online adaptation of the paper teaching resource. These are provided primarily as summative assessment for the theory contained within a particular Unit Standard.

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Appendices

Appendix A: Ethical Clearance

Page 1 – Cover Sheet

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

APPLICATION FOR ETHICAL CLEARANCE/APPROVAL OF RESEARCH PROJECTS 2009

- All research activities undertaken by staff and higher degree students at the University of Canterbury College of Education (UCCE), must obtain Ethical Clearance or Ethical Approval unless they are exempt according to the definitions below.
- Before making an application to the Ethical Clearance Committee, all researchers should read the Ethical Guidelines for the Conduct of Research.
- The Principal Researcher must be a UCCE staff member or student. For collaborative projects, the principal researcher is responsible for all aspects of project management, including applying for ethical clearance/approval and re-applying should circumstances relevant to this application change. All correspondence will be undertaken with the principal researcher.
- Applications to the Ethical Clearance Committee must be received by the Secretary **at least TWO weeks prior** an Ethical Clearance Committee meeting in order to be considered at that meeting.

Written applications should be submitted by internal post to:

Mrs Deborah Wekking
The Secretary of the Ethical Clearance Committee
Level 6, Registry
University of Canterbury

Phone: +64 3 364 2241, Extension 6241
Email: Deborah.wekking@canterbury.ac.nz

NB – Please also submit an electronic copy to the Secretary.

PROJECT DETAILS

TEACHER/ RESEARCHER: **Malcolm John Hay**

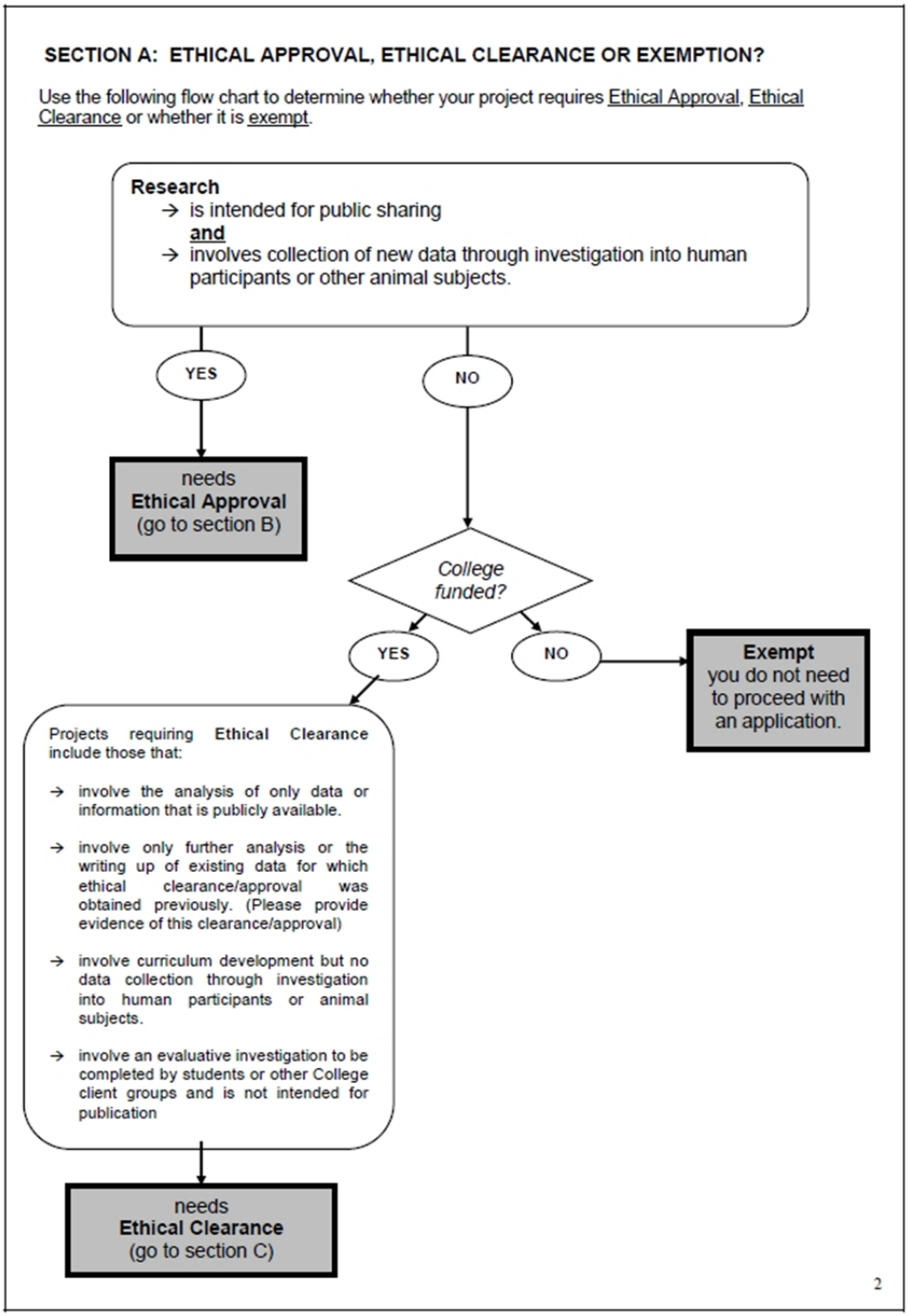
Email Address & Postal Address: m.hay@oc.school.nz
33 Cranston Street, Torbay, Auckland
Phone: (09)473 3596

SCHOOL / ADMINISTRATIVE AREA: Technology Department

ASSOCIATE RESEARCHER/S:
None
PROJECT TITLE:
Developing effective online resources to encourage independent learning in carpentry. (2nd Cycle)

1

Page 2- Flow Chart



Page 3 – Project Description

SECTION B: ETHICAL APPROVAL

1. DESCRIPTION OF THE PROJECT

It is my intention to gauge the effects of the interactive resources on student achievement and also to observe how they affect independent learning in the students.

As resources such as these become more widely available and become even more user-friendly, this topic is likely to become more current which makes this study relevant and useful for other teachers who wish to take advantage of modern technology in their teaching.

In addition to this, intends to implement these technologies school-wide in the near future. The information that can be gleaned from a study such as this may help the teachers maximise the effectiveness of their resources.

The study of these students could also help students achieve to the best of their ability using media that they are comfortable with.

The study is to be carried out in four parts.

1. The experiences of myself, as a teacher, and other staff members will be investigated to provide a basis for the adaptation of the current resources.
2. Resources and tasks in carpentry will be adapted and the tasks will be carried out by the students. Online interactions will be recorded in the system for later analysis.
3. A conference will be carried out with a group of volunteers to gain insights into personal experiences during this trial.
4. Analysis of the overall results to answer the question

   How do my carpentry students interact with the online resources provided on my school's Online Learning Environment, Ultranet?

Ethical Issues:
All findings and data will be secured on the researcher/teachers own laptop or locked cabinet, thereby restricting unwanted access.
All students and teachers will be allocated pseudonyms and care taken to maintain the anonymity of the participants.
Results of this study will be made available to the participants prior to publication and may be checked for accuracy. Participants may withdraw from the study up to this point.

Although the school will not be named, it may be obvious to those reading any publication which school has been involved in the research. It will not be possible to identify individual students or teachers and the extent of their participation in this project.

Permission to carry out this study has already been obtained from the above persons verbally and will be formalised in writing.

The researcher undertakes to adhere to the Code of Ethics developed by the University of Canterbury.

3

Page 4 - Questionnaire

2. WHICH OF THE FOLLOWING CATEGORIES BEST DESCRIBE YOUR RESEARCH PROJECT?
(Please tick one box only)

- ☒ Educational or social science research involving humans
- ☐ Psychological research involving human and/or animals
- ☐ Scientific research involving humans and/or animals
- ☐ Other (Please specify)

3. WHAT IS THE PURPOSE OF YOUR RESEARCH PROJECT?
(Please tick one)

- ☐ Staff research
- ☐ PhD research
- ☒ Honours, MTchLn or Level 8 Research

Please indicate name of supervisor/s Professor Niki Davis

4. WILL THIS PROJECT REQUIRE ETHICAL APPROVAL FROM OTHER BODIES?
e.g. University of Canterbury Human Ethics Committee

- ☐ NO
- ☒ YES
If yes, explain how this approval has been / will be obtained in the space below and attach copies of relevant correspondence.

Permission to carry out this study has already been obtained from the Associate Principal persons verbally and will be formalised in writing in a letter of understanding.

5. IS THIS PROJECT BEING EXTERNALLY FUNDED?

- ☒ NO
- ☐ YES *(Please specify by whom in the space below)*

4

Page 5 - Questionnaire

6. WHAT METHODS WILL BE EMPLOYED IN CONDUCTING YOUR RESEARCH?
(Please tick more than one box if needed)

☒ Examination of normal educational practice or education instructional strategies, instructional techniques, curricula, or classroom management methods, journal, existing data, documents etc.

☐ Questionnaires or surveys

☐ Examination of medical, educational, personnel or other confidential records

☐ Observation (covert)

☒ Observation (overt)

☒ Structured interviews

☒ Unstructured group conferences

Please explain any significant aspects. Includes a focus group.

☐ Procedures involving physical experiments (e.g. exercise, reaction to computer images)

☐ Procedures involving administration of substances (e.g. drugs, alcohol, food)

☐ Physical examination of participants (e.g. blood pressure and heart and temperature monitoring)

☐ Collection of body tissues or fluid samples

Please give more details including how health and safety issues will be managed.

☐ Other (please specify below, stating any significant aspects)

5

Page 6 - Questionnaire

7.(a) WHAT ARE THE EXPECTED AGES OF YOUR PARTICIPANTS?

- ☐ Children (under 14)
- ☒ Young people (14-17)
- ☒ Adults (18 and over including College/University students)

(b) WILL THIS PROJECT REQUIRE APPROVAL FOR ACCESS TO THE PARTICIPANTS FROM OTHER INDIVIDUALS OR BODIES?
E.g., parents, guardians, school principals, teachers, boards, responsible authorities, etc.?

- ☐ NO
- ☒ YES *(Please specify who)*

The Associate principal in charge of this area and the Teacher in Charge of the implementation of OLEs in the school.

8. (a) ANONYMITY OF PARTICIPANTS AND CONFIDENTIALITY OF DATA
Please tick YES or NO for each

YES	NO	
☒	☐	Will complete anonymity of participants be guaranteed?
☒	☐	Will records remain confidential and access to data be restricted?

(b) VOLUNTARY PARTICIPATION AND COMPLAINTS PROCEDURE
Please tick YES or NO for each

YES	NO	
☒	☐	Are participants able to withdraw from the project at any time without penalty?
☒	☐	Will participants be made fully aware of the College's complaints procedure should they have any concerns regarding the researcher or the project?

*If you answered **no** to any of the questions above, in 8(a) or 8(b), please provide additional information below explaining why these procedures are not being followed and how potential risks to participants will be minimised.*

6

Page 7 - Questionnaire

9. ARE THERE ANY FORSEEABLE RISKS TO THE PARTICIPANTS?

Please tick YES or NO for each

YES	NO	
☒	☐	Social risks
☐	☒	Legal risks
☐	☒	Psychological risks
☐	☒	Health and safety risks
☐	☒	Cultural risks
☐	☒	Any other risks

*If you answered **yes** to any of the above, please provide additional information below explaining the nature of the risk and how it will be minimised.*

The research is a small addition to normal classroom teaching and aims to improve it.

The name of the school may be ascertained by those reading the research findings, especially if the researcher is known to them. It will, however, not be possible to identify individual students or their personal contribution to the research project.

10. ARE THERE ANY OTHER ETHICAL ISSUES THAT SHOULD BE DRAWN TO THE ATTENTION OF THE ETHICAL CLEARANCE COMMITTEE?

☐ NO

☒ YES

*If you answered **yes**, please provide additional information below explaining the ethical issue(s) and how it will be addressed.*

Permission has been sought and granted to carry out this study. This will be confirmed in writing.
The school management is keen for studies of this kind to be carried out by staff assist in internal professional development for all staff with the aim to improve current online teaching practice in the school.

The researcher undertakes to adhere to the Code of Ethics developed in the Action Research course EDTL894 and the University of Canterbury. This Code of Ethics will be carried forward to this second cycle of the Action Research project for EDTL905.

7

Page 8 – Check Sheet

11. PARTICIPANT INFORMATION SHEET

Please attach a copy of the Information Sheet that you will provide to participants in your study.

The Ethical Clearance Committee has strict but simple requirements for Participant Information Sheets.

12. CONSENT FORM

Please attach a copy of the consent form(s) that participants in your study will sign.

The Ethical Clearance Committee has strict but simple requirements for Consent Forms (click here). These guidelines must be followed or your application will not be considered.

13. ACADEMIC APPROVAL (Students only)

Please attach evidence that you have academic approval to undertake your research.

Students enrolled in the MTchLn programme, should attach a copy of the letter from the Academic Standards Committee indicating that your project has been granted Academic Approval.

Students of other institutions should provide similar evidence of approval or requirement by their institution.

Section B continues over page

8

Page 9 - Declaration

14. DECLARATION

I AM APPLYING FOR **ETHICAL APPROVAL** FOR THE RESEARCH PROJECT AS OUTLINED ABOVE.

I have read the *Ethical Guidelines for the Conduct of Research* and I am aware of the implications of my research project. I understand the details of the Privacy Act mentioned in these guidelines and how they influence the subjects I choose as participants in my research work.

The project has been accurately described in this application and I have included all the necessary documents and information to support my application.

I undertake to reapply should circumstances relevant to this application change.

Principal Researcher's Name **Malcolm John Hay** Date: 30.09.2009

Signed:

For Academic Supervisor - student projects only

I am fully informed of the research proposal and am satisfied that it meets necessary standards in relation to ethical issues.

Academic Supervisor's Name Professor Niki Davis
Date:

Signed: .....

NB – THIS DECLARATION MUST BE HAND-SIGNED

9

Appendix B: Information Sheets and Consent Forms

Parent Information Sheet

Researcher:
Malcolm Hay
Technology Department

Supervisors:
Professor Niki Davis
School of Literacies and Arts in Education,
College of Education,
University of Canterbury,
Private Bag 4800,
Christchurch 8140
Tel: 03 345 8246

Dr Elaine Mayo
School of Educational Studies and Human Development,
University of Canterbury
Private Bag 4800,
Christchurch 8140
Tel: 03 364 2987

Developing effective online resources to encourage independent learning in carpentry.
Information for Parents/Caregivers

Dear Parent/Caregiver

My name is Malcolm Hay. I am a teacher at and am also currently studying at the University of Canterbury. The purpose of my research project is to provide information for the future development of interactive resources for the online learning environment "Ultranet" that is being introduced at the college.

I would like your child to participate in this research project. There will be no extra work involved for your child as the data for the research will be mainly gathered by observing normal classroom activity and the way the students interact with the learning resources online. Information will also be gathered during informal class discussions. As the study is an observation of normal course activity, the only difference between students participating in the research and those who do not is that the participants' data will be included in my research and used to help with the future development of new online learning resources.

If your child wishes to withdraw from the research project at any time prior to the submission of my thesis, they may do so without any repercussions or penalties as participation is strictly voluntary. If they wish, any of the data directly involving them will also be removed from the research project.

None of the data that has been collected will be analysed until after all of their assessments are complete. This is to ensure that your child does not feel pressured into having to participate or not being able to pull out and means that the research project and the course assessment remain completely separate. All of the data will be treated as confidential and no data that could be used to identify your child specifically or the school will be published. The notes taken during class discussions will not be a word for word transcript but will be used to record general ideas and themes as they arise. All data will be kept secure on my computer or in a locked cabinet to protect anonymity. It will be kept for a minimum of five (5) years following the completion of the project, after which time it will be destroyed.

Should you agree for your child to take part in the research, please sign the consent form that is attached to this information sheet. Your child has also been given an information sheet and consent form to sign.

If you have any questions about this project you can talk to me. If you have any complaints about the way the research you may also contact the Chair of the University of Canterbury Educational Research Human Ethics Committee. The contact details are at the foot of this page.

Signed: _____ Date: _____
University of Canterbury College of Education

---

1. This project has received ethical approval from the University of Canterbury Educational Research Human Ethics Committee.
2. Complaints may be addressed to:
   Dr Missy Morton
   Chair of the Educational Research Human Ethics Committee
   College of Education, University of Canterbury
   Private Bag 4800, CHRISTCHURCH Telephone: 0 3 345 8312

Parent Consent Form

Researcher:
Malcolm Hay
Technology Department

Supervisors:
Professor Niki Davis
School of Literacies and Arts in Education,
College of Education,
University of Canterbury,
Private Bag 4800,
Christchurch 8140
Tel: 03 345 8246

Dr Elaine Mayo
School of Educational Studies and Human Development,
University of Canterbury
Private Bag 4800,
Christchurch 8140
Tel: 03 364 2987

Developing effective online resources to encourage independent learning in carpentry.
Parent/Caregiver Consent Form

I give permission for _____ to participate in the project, *Developing effective online resources to encourage independent learning in carpentry.*

I have read and understood the information given to me about the research project and what will be required of my child/the child in my care.

I have discussed the project with _____ and am happy that he/she understands what will be required of him/her and that he/she can withdraw at any stage without fear of any repercussions or penalties.

I understand that anything my child says during research discussions and observations will be treated as confidential. No findings that could identify my child or his/her school will be published. The forms used and research data will be kept secure to protect anonymity.

I have been assured that participation or non-participation in or withdrawal from this research project will not influence assessment or assessment results in any way.

I also understand that my granting permission for my child's participation in this project is voluntary and that if I change my mind I can withdraw my child at any time without repercussions or penalties for my child.

Name: _____

Date: _____

Signature: _____

Please return this form along with the student's consent form to* Mr M. Hay *(the project coordinator at your child's school).

---

1. This project has received ethical approval from the University of Canterbury Educational Research Human Ethics Committee.
2. Complaints may be addressed to:
   Dr Missy Morton
   Chair of the Educational Research Human Ethics Committee
   College of Education, University of Canterbury
   Private Bag 4800, CHRISTCHURCH Telephone: 0 3 345 8312

Student Information Sheet

Researcher:
Malcolm Hay
Technology Department

Supervisors:
Professor Niki Davis
School of Literacies and Arts in Education,
College of Education,
University of Canterbury,
Private Bag 4800,
Christchurch 8140
Tel: 03 345 8246

Dr Elaine Mayo
School of Educational Studies and Human Development,
University of Canterbury
Private Bag 4800,
Christchurch 8140
Tel: 03 364 2987

Developing effective online resources to encourage independent learning in carpentry.
Information for Carpentry Students

Dear student,

My name is Malcolm Hay and, in addition to being your teacher, I am undertaking a course of study through the University of Canterbury's College of Education. My research project is looking at how you work with the exercises and information you have been given in Ultranet so that these can be improved to provide you with better resources in the future.

If you choose to take part in this study you will not notice any difference in the way you are treated and you will not be asked to do more work as I will be observing normal working patterns. The only difference will be that your work habits will be analysed for the research project at the end of the year.

Any notes taken during discussions or observations will be kept secure on my computer or in a locked cabinet to protect anonymity, meaning that your name will not appear anywhere in the data and where an example is given that describes a specific situation, a false name will be used so that you will not be able to be identified. The school will also not be named. The forms and any data recorded will be kept secure for a minimum of five (5) years after the project is finished, after which time it will all be destroyed.

During the study:
- Your work habits and achievement will be recorded in exactly the same way as your results are normally kept.
- You will not have to try harder than you normally would as we are looking for your genuine response to the new learning resources.
- The data will only be analysed at the end of the year, after your grades have been entered, so it will not change your results if you participate or not. It will also make no difference if you participate and then withdraw as it is your work habits and not your results that are being observed.

There are no repercussions or penalties if you pull out of the study at any time up to the date of printing the final version of the research, and any data directly involving you will be removed from the study if you wish.

If you are happy to participate, you will need to sign the consent form and return it to me. Your parents/caregivers will need to sign a consent form too. If you have any questions you can talk to me or your parents/caregivers.

Signed: _____ Date: _____
University of Canterbury College of Education

1. This project has received ethical approval from the University of Canterbury Educational Research Human Ethics Committee.
2. Complaints may be addressed to:
   Dr Missy Morton
   Chair of the Educational Research Human Ethics Committee
   College of Education, University of Canterbury
   Private Bag 4800, CHRISTCHURCH Telephone: 0 3 345 8312

Student Consent Form

Researcher:
Malcolm Hay
Technology Department

Supervisors:
Professor Niki Davis
School of Literacies and Arts in Education,
College of Education,
University of Canterbury,
Private Bag 4800,
Christchurch 8140
Tel: 03 345 8246

Dr Elaine Mayo
School of Educational Studies and Human Development,
University of Canterbury
Private Bag 4800,
Christchurch 8140
Tel: 03 364 2987

Developing effective online resources to encourage independent learning in carpentry.
Student Consent Form

My teacher and I have talked about the online learning project he is working on this year.

- I have read and understood the information provided and am happy to take part in this project.
- I understand that it is my work patterns and engagement with the resources which will be noted and used as data for the study
- I understand that my name will not be written down next to any of the results of the analysis.
- I understand that notes taken during class discussions will be treated as confidential and will not be used to identify me in any way.
- I understand that I can withdraw from this study at any time up to the submission of the project without any repercussions or penalties.
- I know that the forms and data will be kept in a safe place for five (5) years after the project is finished and that they will then be destroyed.
- I understand that taking part in this project will not affect my grades as they will be submitted before any data analysis takes place.

Name: _____

Signed: _____

Date: _____

1. This project has received ethical approval from the University of Canterbury Educational Research Human Ethics Committee.
2. Complaints may be addressed to:
   Dr Missy Morton
   Chair of the Educational Research Human Ethics Committee
   College of Education, University of Canterbury
   Private Bag 4800, CHRISTCHURCH Telephone: 0 3 345 8312

Memorandum of Understanding between the researcher and the school

Developing effective online resources to encourage independent learning in carpentry.

Memorandum of understanding between:

Malcolm Hay
Student
University of Canterbury

M
Assistant Principal

In the course of study for the paper EDTL905 as part of the Master of Teaching and Learning through the University of Canterbury, Malcolm is researching the question:

How do my carpentry students interact with the online resources provided on my school's Online Learning Environment, Ultranet?

Malcolm explained that other staff members trialling the Ultranet will be questioned on a voluntary basis to provide a basis for the adaptation of the current resources.

It was also agreed that student participation should be on a voluntary basis with no repercussions for those not taking part or withdrawing from the investigation.

Ethical Issues and issues of confidentiality raised:

- All findings and data will be secured on the researchers own laptop and any paperwork will be kept in a locked cabinet thereby restricting unwanted access.
- All students and teachers will be allocated pseudonyms and care taken to maintain the anonymity of the participants.
- The raw data will only be analysed once the students' assessment results have been finalised.
- Results of this study that identify the school will only be revealed in consultation with the school's senior management.

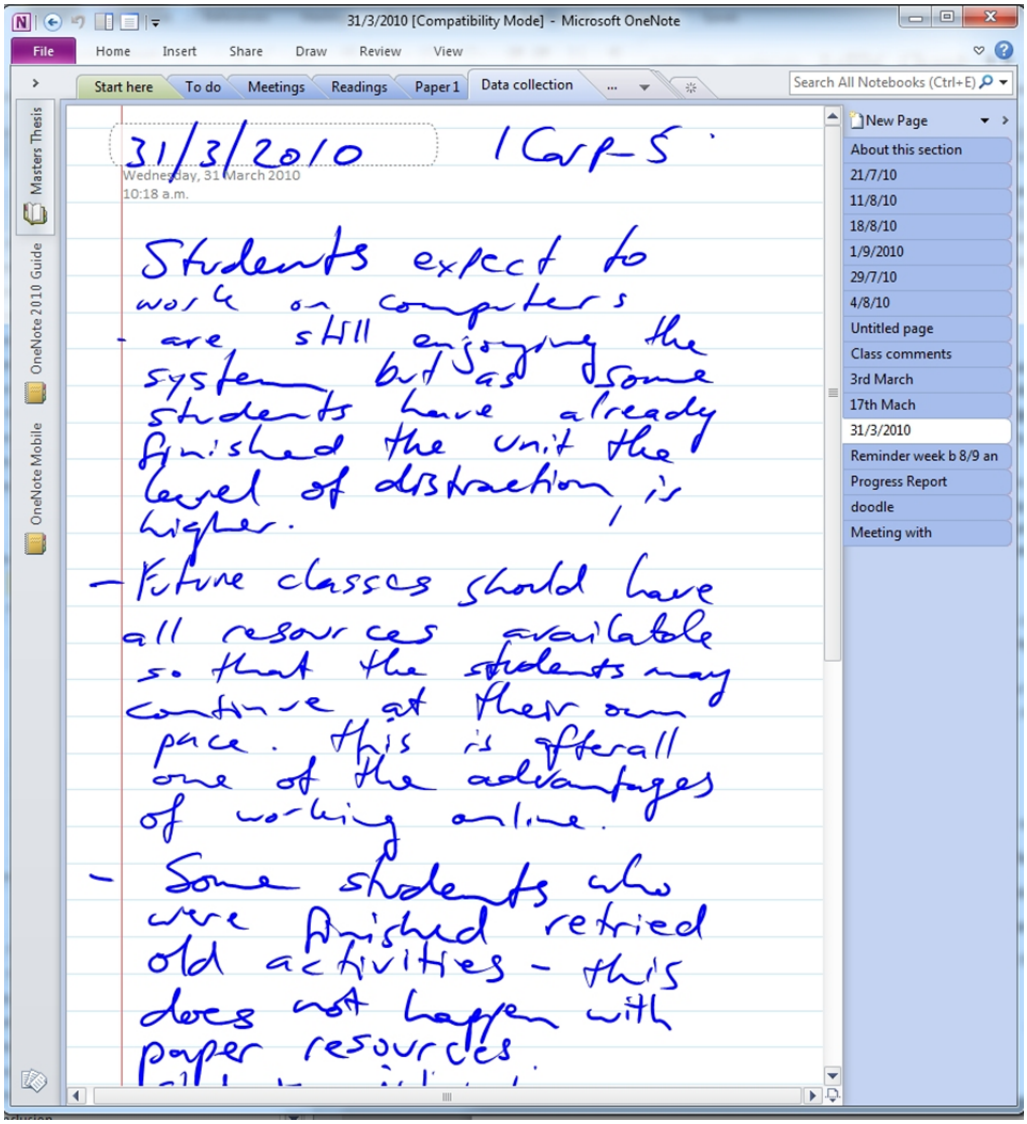
In the discussion, the objectives of the EDTL905 course were outlined and it was agreed that these did not conflict with the interests and policies of the school.

Mark was happy for Malcolm to carry out this task and permission was granted for him to start.

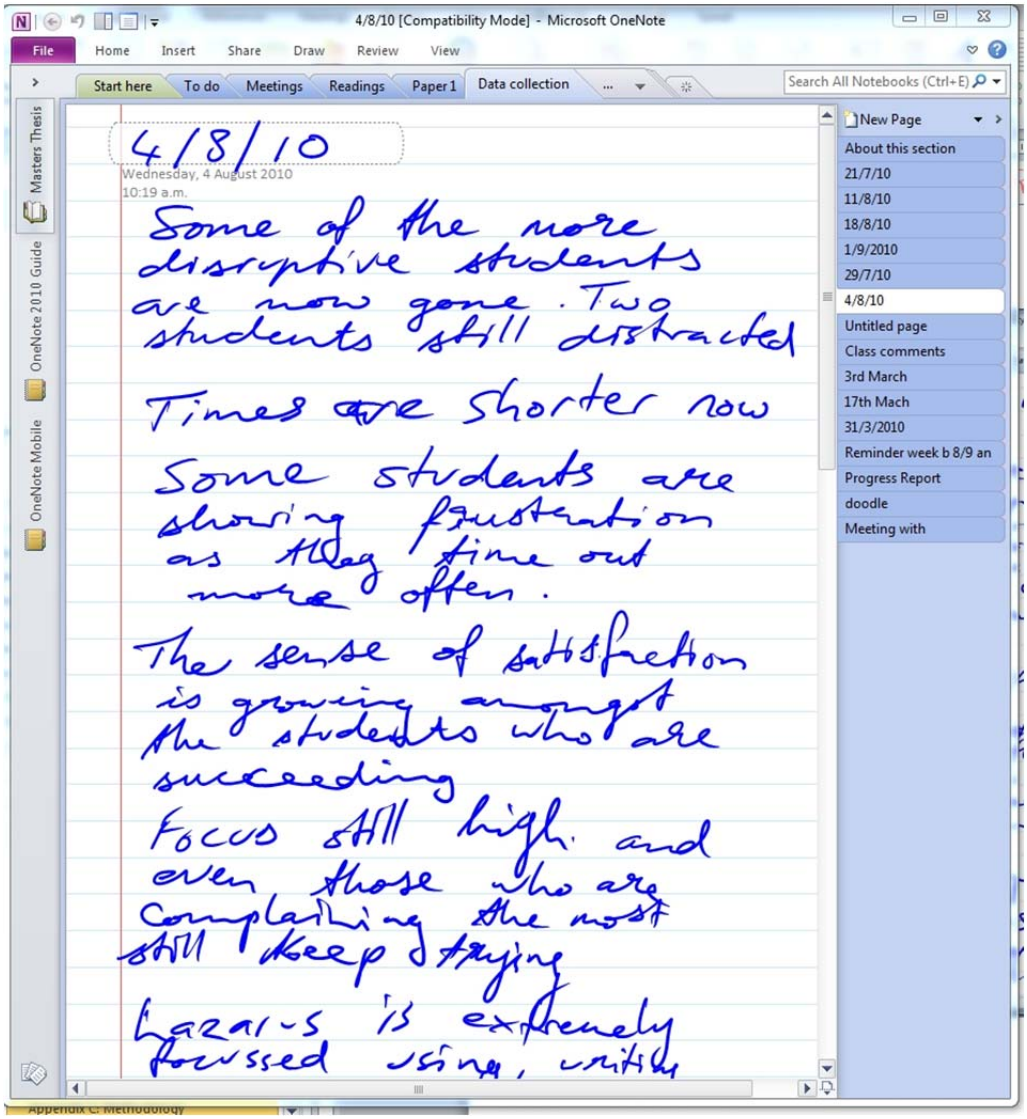
Signed: _____ _____
M Malcolm Hay

Appendix C: Examples of Field Notes on a tablet PC using One Note

Example A



Example B


4/8/10 [Compatibility Mode] - Microsoft OneNote
File
Home
Insert
Share
Draw
Review
View
Start here
To do
Meetings
Readings
Paper 1
Data collection
Search All Notebooks (Ctrl+E)
Masters Thesis
OneNote 2010 Guide
OneNote Mobile
4/8/10
Wednesday, 4 August 2010
10:19 a.m.
Some of the more disruptive students are now gone. Two students still distracted
Times are shorter now
Some students are showing frustration as they time out more often.
The sense of satisfaction is growing amongst the students who are succeeding
Focus still high and even those who are complaining the most still keep staying
Lazarus is extremely focussed using, within
New Page
About this section
21/7/10
11/8/10
18/8/10
1/9/2010
29/7/10
4/8/10
Untitled page
Class comments
3rd March
17th Mach
31/3/2010
Reminder week b 8/9 an
Progress Report
doodle
Meeting with

Appendix D: Examples of Student Work.

Figure 34: Orthographic Projection for Unit Standard 7502 (Student 1-09)

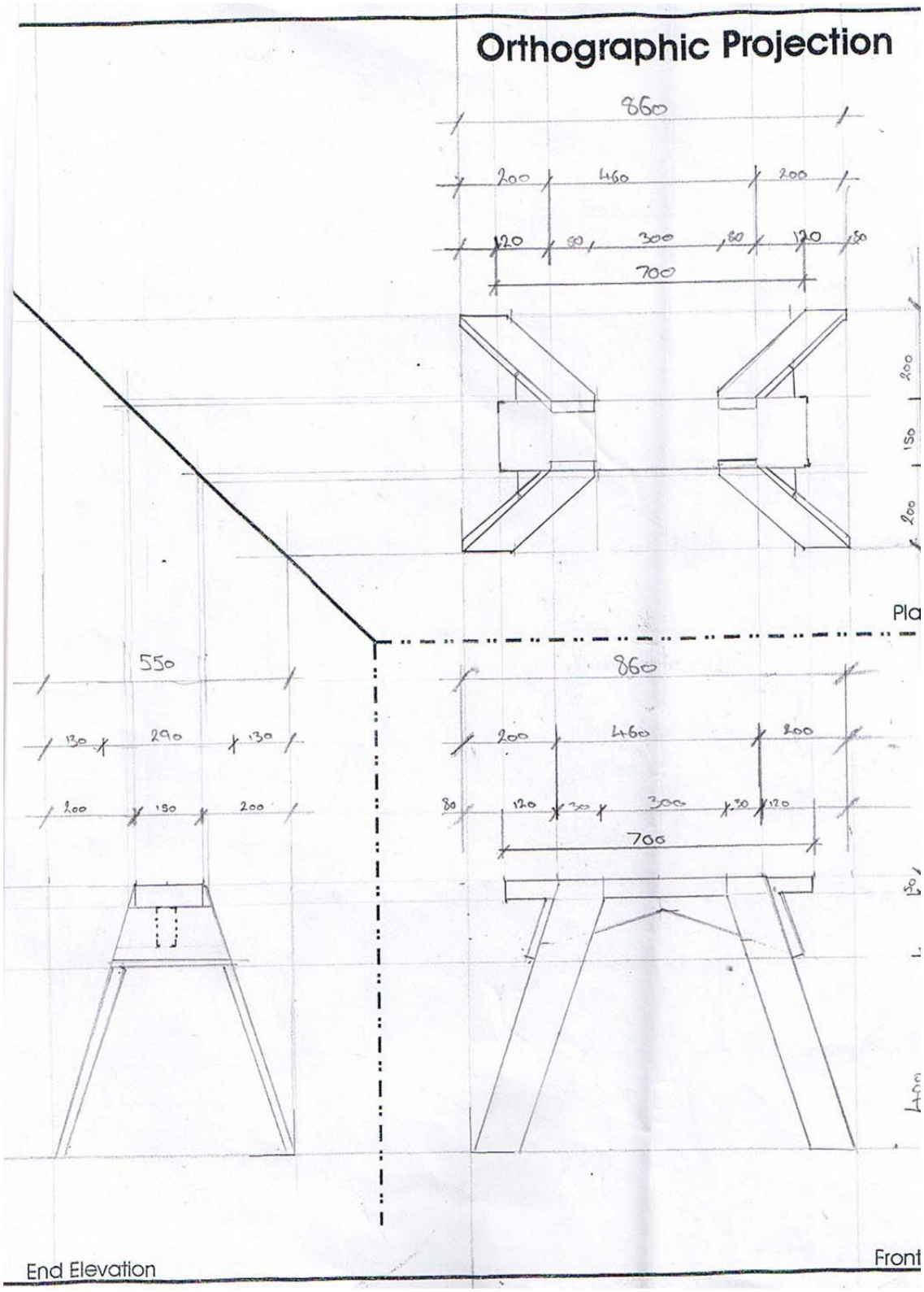


Figure 35: Orthographic Projection for Unit Standard 7502 (Student 1-01)

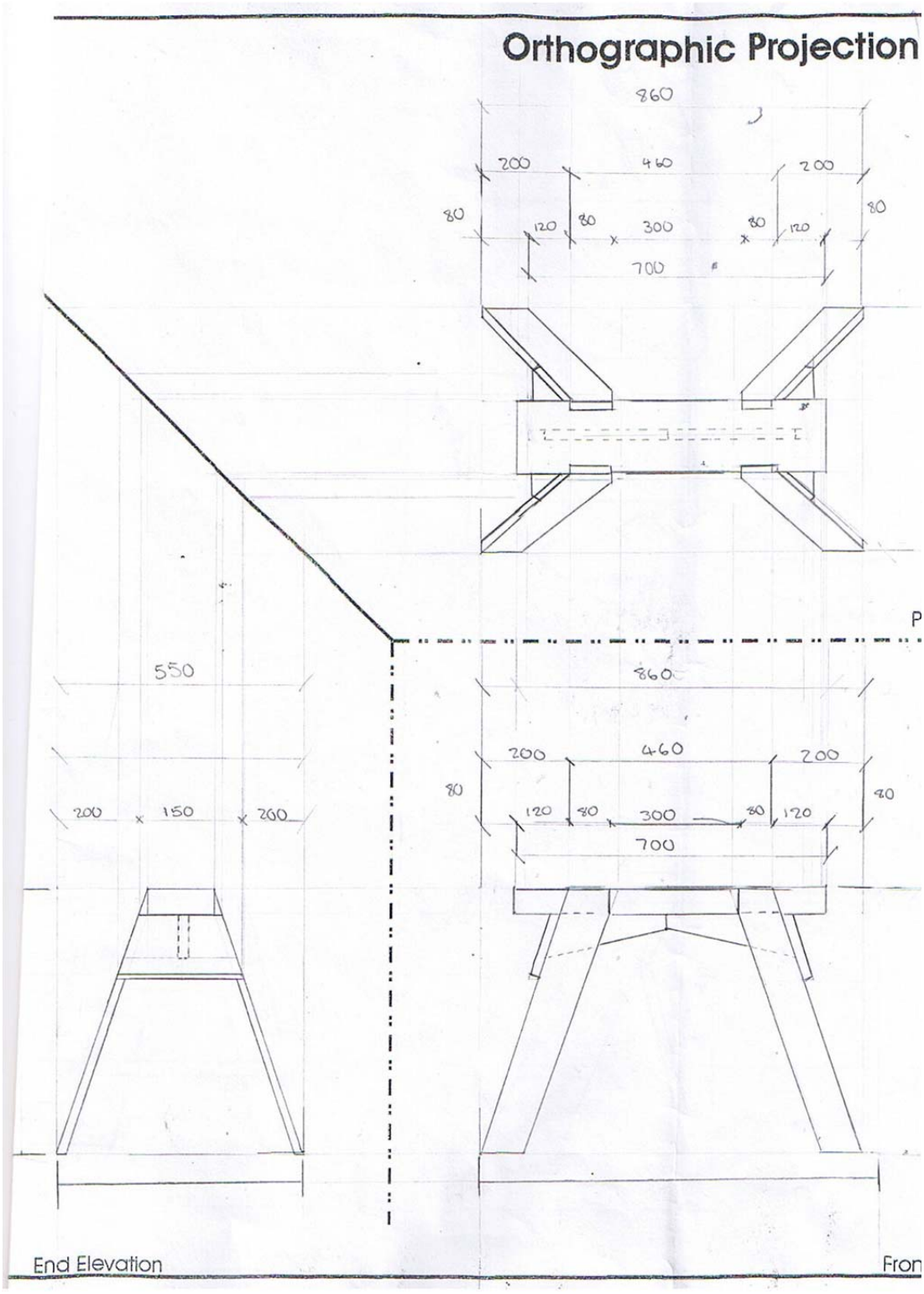
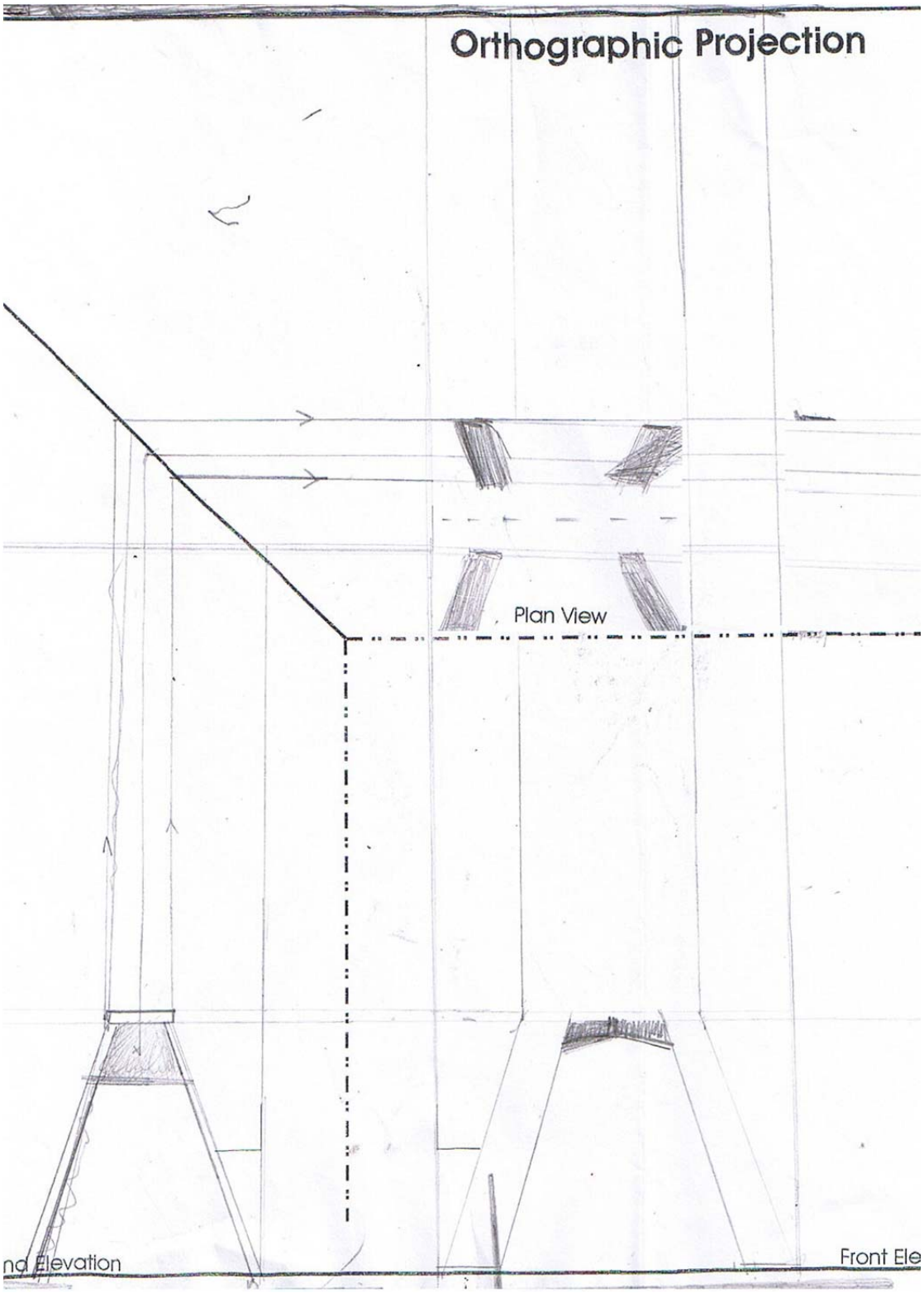


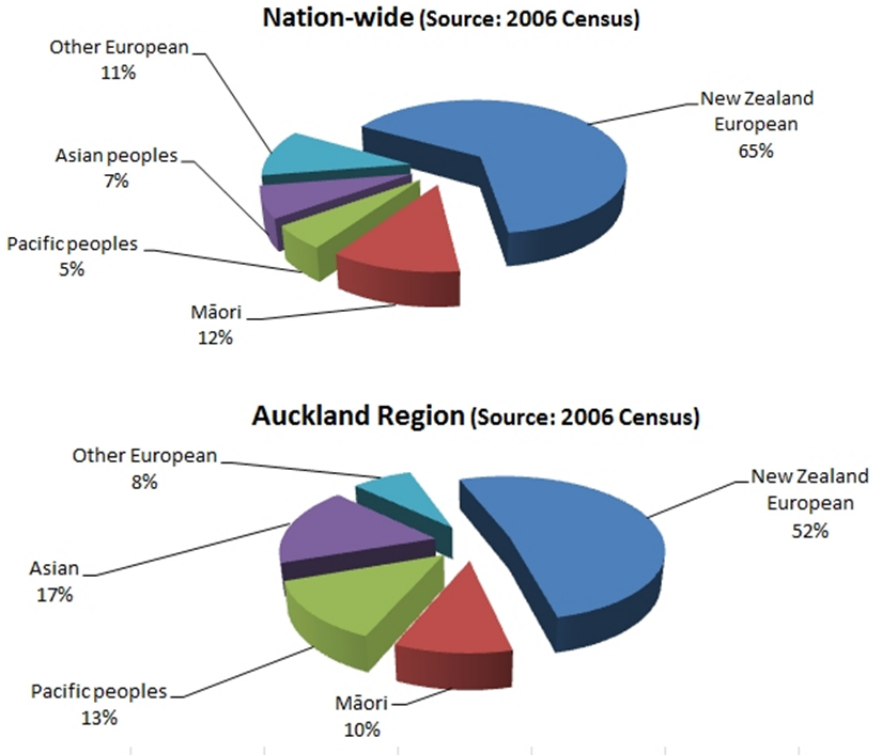
Figure 36: Orthographic Projection for Unit Standard 7502 (Student 2-16)

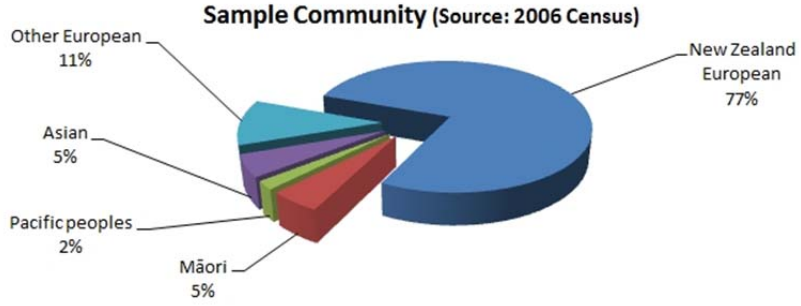


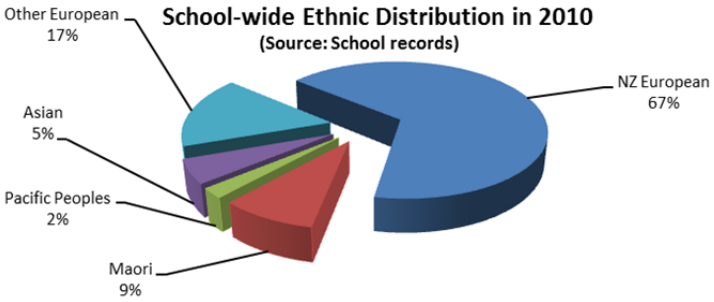
Appendix E: Participant Ethnic Distribution

The two classes were ethnically diverse. Data derived from school records, the Statistics New Zealand 2006 Census and Statistics New Zealand websites allowed comparison between the ethnic distribution of the school (Figure 37) and that of New Zealand, the Auckland region and the local Sample Community (Figure 37). The Sample Community had a 20% higher concentration of New Zealand European/Pakeha than Greater Auckland. Maori, Pacific and Asian peoples make up a combined total of just 12% of the population, considerably lower than the region as a whole. The ethnic distribution of the community is closer to that of the national distribution although, even here, the Maori population, at 5%, is still under-represented. This is possibly explained by the large, predominately Pakeha/NZ European 65+ age group where only 3.4% are Maori. The ethnic distribution in the school indicates that the ethnic distribution of the section of the population with school-aged children is closer to the national averages than the community as a whole which is an indication of the changing demographics of the families in the community with school-aged children.

Figure 37: National, regional and local ethnic distribution in New Zealand at the 2006 Census.

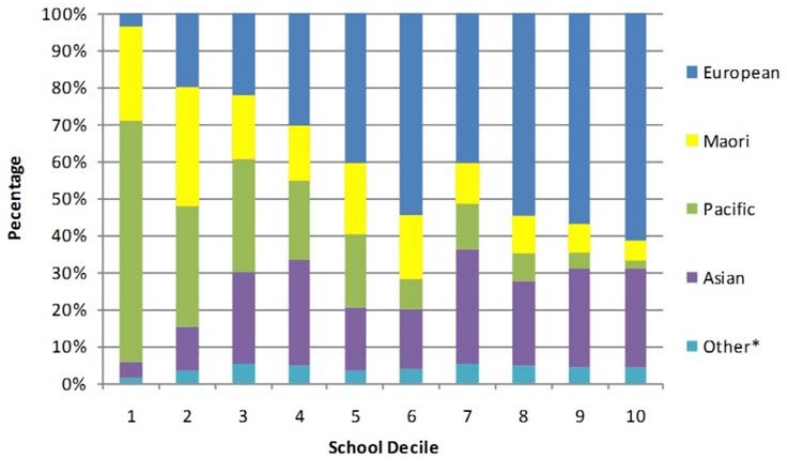






In a comparison with the ethnic distribution in other schools in the Auckland region (Figure 38), the 77% Pakeha/NZ European component was 17% higher than the 60% average of other decile 9 and 10 schools. By contrast, the Asian component, at 5% is 15%–20% lower than the average. Maori and Pacific Island students are represented in numbers that are average for decile 9 and 10 schools in the region.

Figure 38: Auckland region school students by ethnicity and school decile from the Tertiary Education Commision (2008).

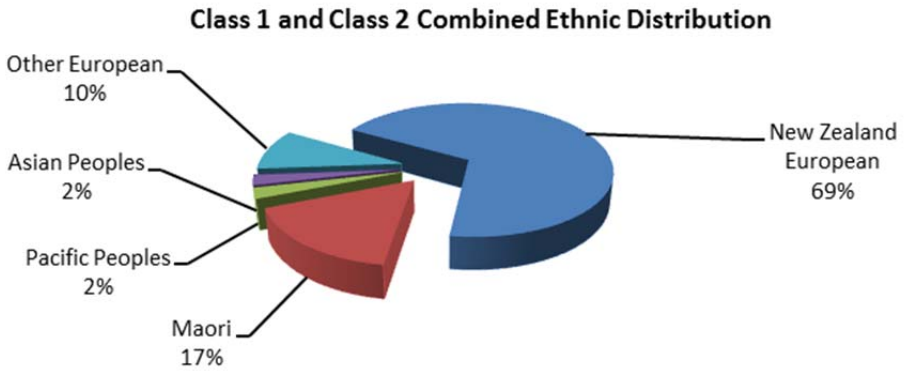


Source: Tertiary Education Commission at http://www.tec.govt.nz/Resource-Centre/Reports/The-Auckland-study/ . Accessed 08.08.2011

Figure 39: Ethnic Distribution in the Combined Carpentry Classes based on School Enrolment Records 2010. shows that almost double the number of Maori students and half the number of Asian students opted to take Carpentry than would otherwise be expected if the ethnic distribution was proportional throughout the subjects in the school. Class 2 had no representatives of either the Asian or Pacific ethnic groups and neither of the Asian or Pacific students in Class 1 chose to participate in the sample group. As only one student from each ethnic group was represented, this would have resulted in the success or failure of these students contributing to 100% of the result for their particular ethnic group. The remaining groups were proportionately represented.

According to reports to the Human Rights Commission (McGregor & Gray, 2003) and the Department of Building and Housing(Building and Construction Sector Productivity Task Force, 2008), these results reflect the ethnic distribution in the building industry as a whole where both Maori and Pakeha/NZ Europeans are proportionately represented with the other ethnic groups slightly under represented.

Figure 39: Ethnic Distribution in the Combined Carpentry Classes based on School Enrolment Records 2010.



The separation of the two classes revealed that the New Zealand European/Pakeha and Maori ethnic groups were proportionately distributed. Figure 40 shows the breakdown of the ethnic distribution of students in the two sample groups whose results and other data contributed to this study.

Figure 40: Ethnic distribution in each of the two Sample Group classes based on school enrolment records 2010.

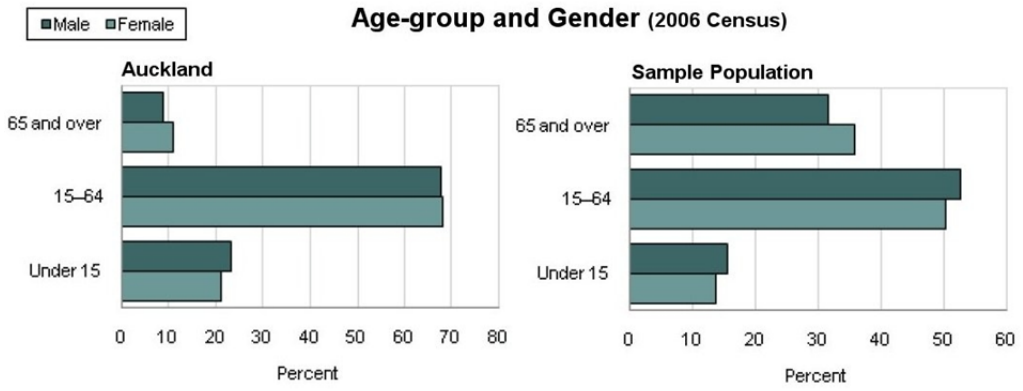
Although the two sample groups are different in size, the ethnic distribution is similar and unlikely to be a contributing factor for differences in achievement between the two classes.

Appendix F: Participant Gender

Statistics from the New Zealand Census (Statistics New Zealand, 2006), show there are approximately 105 male births for every 100 female in New Zealand giving a sex ratio of 1.05. Data from other countries shows the ratio tends to be between 1.04 and 1.07

The 2006 census shows the Sample Community as having 3,351 male as opposed to 3,975 female residents, giving a sex ratio of 0.84, a total of 823 lower than the national average. As in the ethnic data, this discrepancy is able to be traced back to the large 65+age group influencing the male/female ratio as Figure 41 demonstrates.

Figure 41: Comparing the age and gender of the Auckland population with that of the local Sample Population based on the 2006 census.



(Source:http://www.stats.govt.nz/Census/2006CensusHomePage/QuickStats/AboutAPlace/SnapShot.aspx?pdf=1&tab=Agesex&id=3505805. Accessed 12.08.2011)

In 2010 the school had 984 male students and 907 female students, giving a sex ratio of 1.08, a difference of 32 male students above the national average of New Zealand but still within a range that can be seen as approximately normal.

One girl (2.3% of the Carpentry students) took Carpentry in 2010 but chose not participate in the study. It is not the purpose of this study to investigate the reasons behind the low numbers of girls opting to take this subject, however, as this pre-trade course is designed to lead directly to an apprenticeship, it is interesting to note that in 2003 women made up only 0.7% of all Carpentry apprentices (McGregor & Gray, 2003). By 2006, this figure had risen to 1.79% (Hodgkinson, 2006) which indicates that female students were represented to a similar degree in the carpentry course as the numbers of women choosing to take up apprenticeships in the building construction industry.

Appendix G: Participant Academic Ability

It was necessary to assess the potential academic ability of the students and ascertain how representative the group of participants was relative to the general student population. To do this, the students' "Assessment Tools for Teaching and Learning" (asTTle) results from 2009 were used to indicate the level of literacy and numeracy of the student sample relative to the school averages and national norms. As the asTTle results also greatly influence the school's overall expectations of a student's academic ability, it was important to discover whether these assumptions were correct.

The sample group was compared with the normal distribution of the school population. The school-wide mean for the 2009 Year 10 asTTle results was used in the first data set and the mean of the students' results from the sample group used for the second set. The shaded area in Figure 42 is where 68% of the results would be expected.

Figure 42: Averaged 2009 asTTle Maths and English Year 10 results comparing the Sample Group against the overall school results.

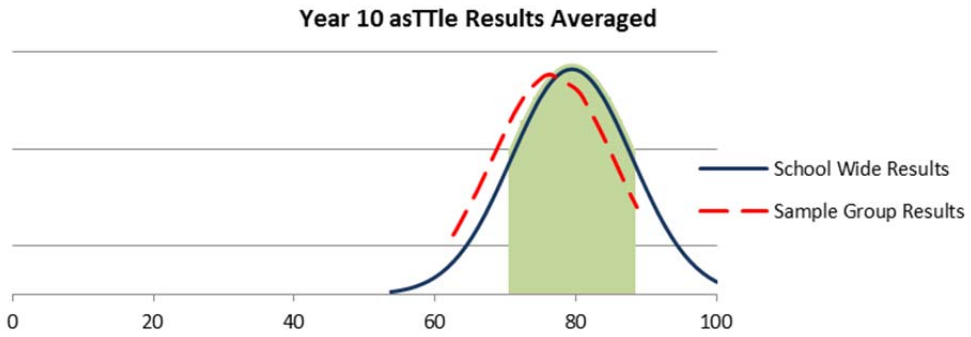
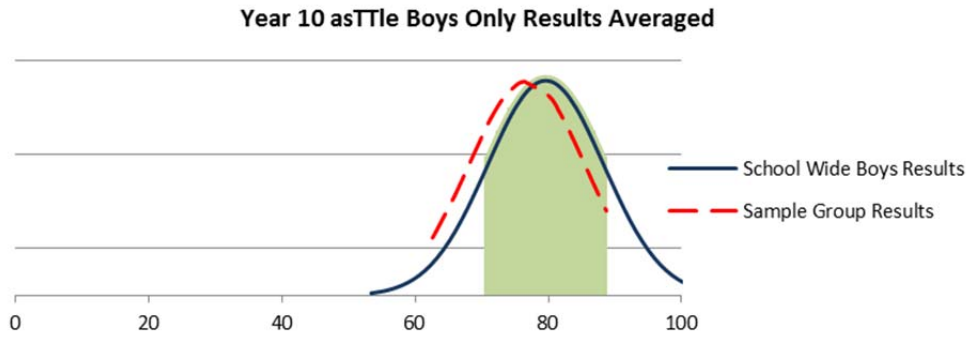


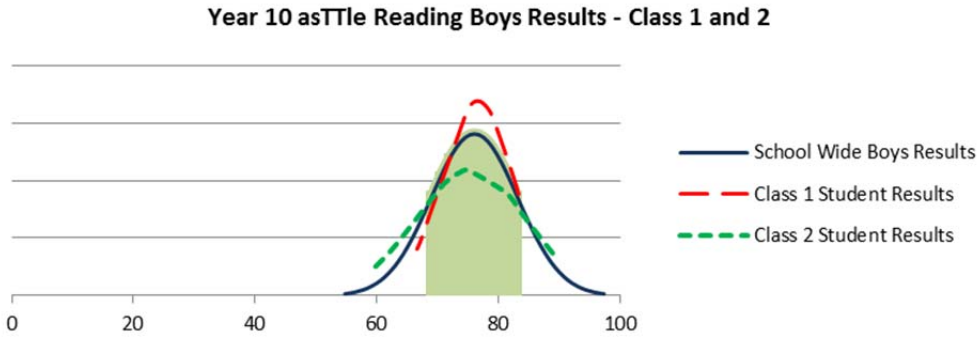
Figure 42: Averaged 2009 asTTle Maths and English Year 10 results comparing the Sample Group against the overall school results. shows that the sample group of students is representative of the school with a mean only 2.5% below the school-wide average. As the sample group was entirely male, the sample groups' results were compared against the school-wide results for boys only (Figure 43). The difference is minimal with the mean for the results school-wide for just the boys being 0.5% higher than for the whole school.

Figure 43:Averaged 2009 asTTle Maths and English Year 10 results comparing the Sample Group against the school-wide boys' results.



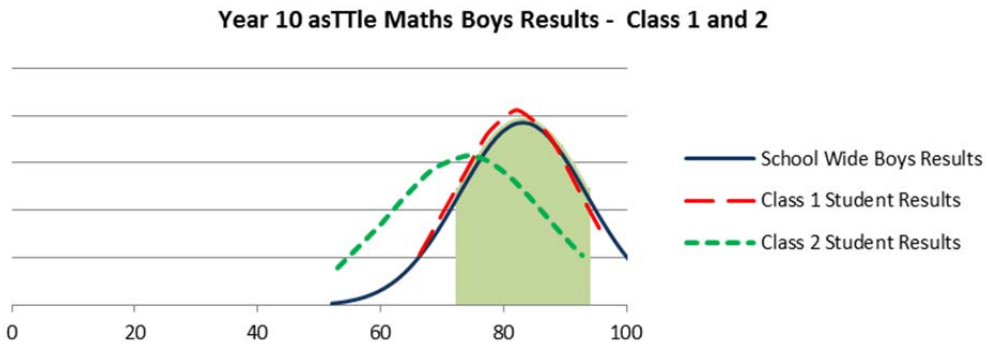
Having ascertained that the results from the sample group were representative of the school-wide results, the Reading and Maths results were separated to look for weaknesses in the sample group and if these were confined to a specific area. The results for Reading achieved by the Sample group closely reflected the results obtained school-wide by boys. Even when the results for Reading were separated into classes and analysed (Figure 44) they differed only +/– 0.5% from the school-wide mean although Class 2 had a slightly lower mean and a wider distribution of results resulting in a somewhat flatter curve.

Figure 44: 2009 Year 10 asTTle Reading results separated into the two Sample Groups - measured against the school-wide results for boys of the same year level.



Analysis of the Maths results showed that the mean of the sample group was 5.5% lower than the results obtained by boys school-wide which was a significant difference and indicated that closer analysis was required. Separate comparison revealed that results for Maths from Class 1 were almost identical to school-wide results. The results from Class 2 were more widely distributed and about 10% lower than those of the school-wide results (Figure 45).

Figure 45: 2009 Year 10 asTTle Maths results separated into the two Sample Groups - measured against the school-wide results for boys of the same year level.



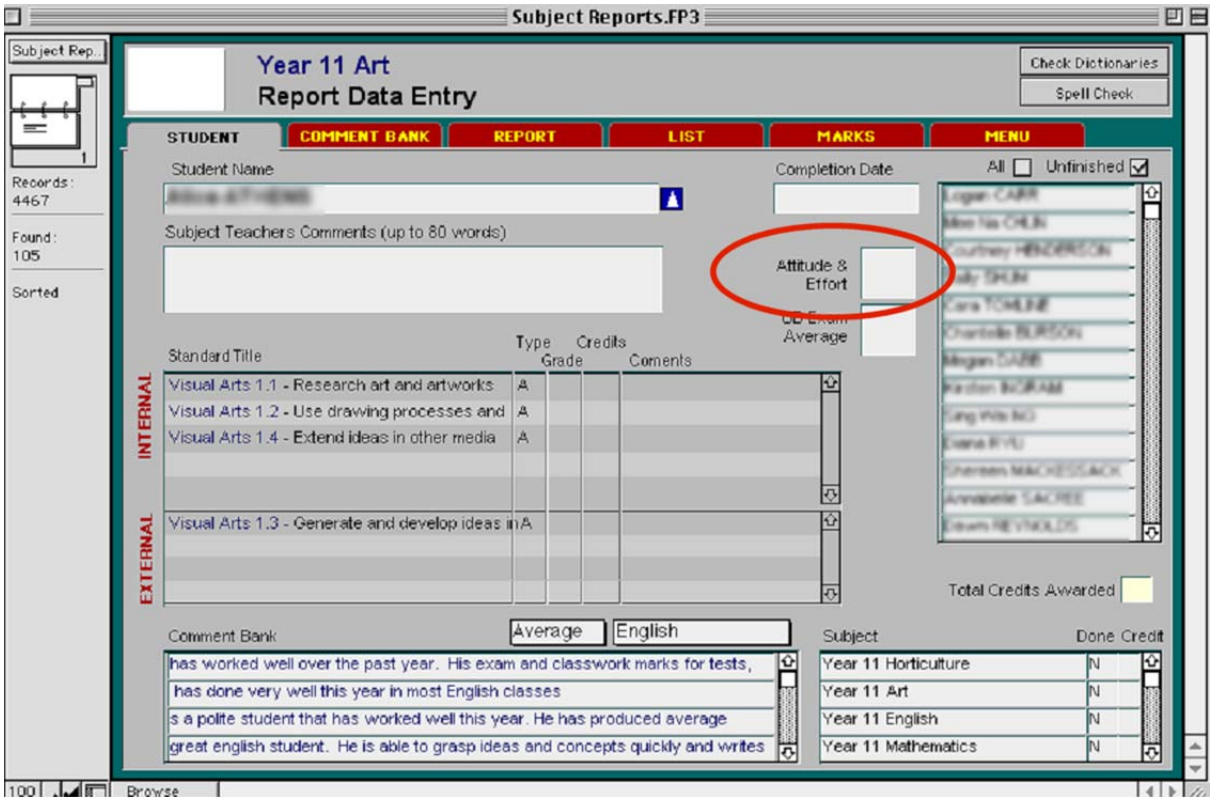
Appendix H: School Report Attitude and Effort

Instructions to teachers regarding the "attitude and effort" grades for student reports.

Excerpt from the school's senior report guidelines:

"It is essential that the comment reflect the achievement and attitude grades. The HOD will moderate the achievement grades. Attitude and effort grades are more subjective and to make them meaningful, consider 3 to be average with a 1 denoting an excellent attitude, a 2 a very good attitude, a 4 attitude needs some improvement and a 5 attitude is quite unsatisfactory. (5 point scale)"

Figure 46 - An example of the graphic user interface (GUI) where comments on student achievement and the attitude and effort grade (circled in red) are entered.



The "attitude and effort" grade is a subjective assessment by the teacher of how well the student applies themselves, both in class and with homework assignments. As it is a composite grade, it is possible for a student who participates willingly but performs poorly academically and an academically gifted student who is reluctant to participate in class to achieve similar results.

For the sake of consistency, the following guidelines have been suggested by the school:

1. A well organised, diligent student who participates fully and consistently meets commitments and deadlines
2. An organised student who usually demonstrates a good work ethic. Generally meets deadlines and work commitments and contributes well in class.
3. A student who does not demonstrate a consistent effort or organisational skills to achieve at their potential.
4. A student who rarely completes work as required and lacks the self-control to use time in class positively, often disregarding the learning of others.